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A better way to look at capital investments . . . . . p. 231

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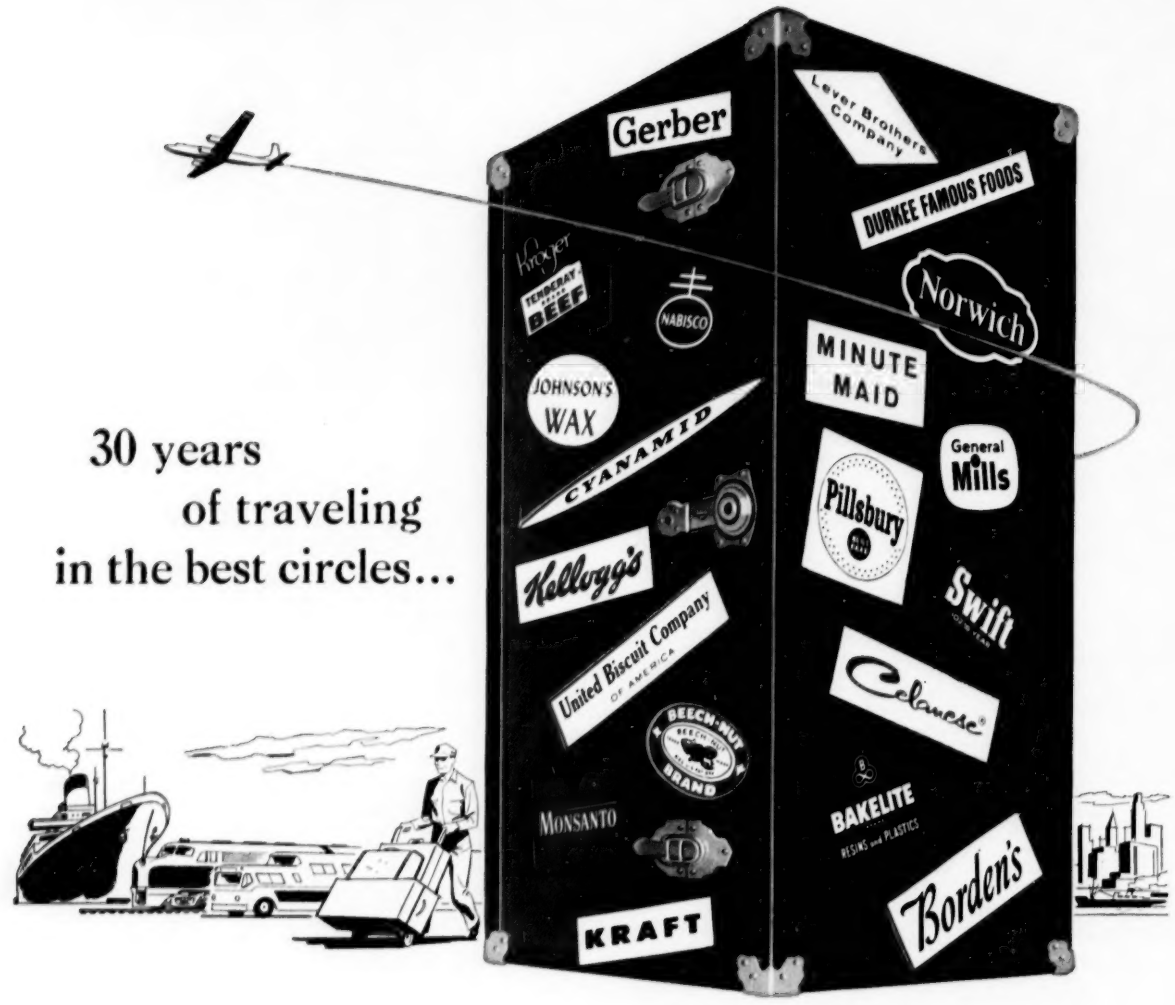
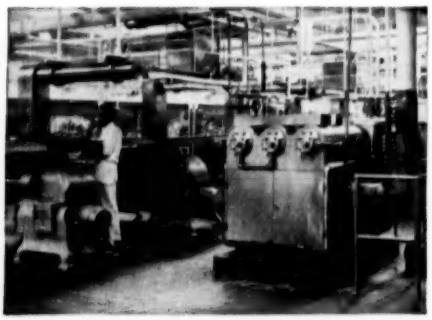


VOTATOR® processing apparatus



More than 85% of U. S. margarine is processed with VOTATOR *Heat Transfer Apparatus. Above: Installation at Jacksonville, Illinois plant of Anderson, Clayton & Co.*

SINCE Girdler introduced continuous heat-transfer processing 30 years ago, VOTATOR* units have been used by hundreds of leading food and chemical companies. The ability of VOTATOR Processing Apparatus to step up quality and profits is the result of unmatched research and experience... and you can put this broad, practical know-how to work in solving *your* problems.

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NOVEMBER 1957

JOHN R. CALLAHAM, Editor-in-Chief

For Engineers, By Engineers

On p. 338 of this issue you'll find a short item on CE's new advertising sales manager, Elton Tuohig.

Unusual angle here is that Elton is a chemical engineer, with 13 years of broad engineering experience before joining CE in 1950 as an advertising salesman.

It's easy to see how Elton's engineering comes in handy; his job is to sell the idea that the best way to sell chemical engineers everywhere is through advertising in CE.

You'll also be interested to learn that experienced chemical engineers now hold virtually every key position on CE's entire staff:

▶ **Publisher**—Wally Traendly; Colgate and Pratt. Technical sales for Victor Chemical and International Nickel; vice president in charge of advertising sales, ACS publications; director of Reinhold Publishing.

▶ **Editorial Director**—Sid Kirkpatrick (Illinois), certainly one of the best known and most highly respected chemical engineers in the U. S.; with CE for 36 years.

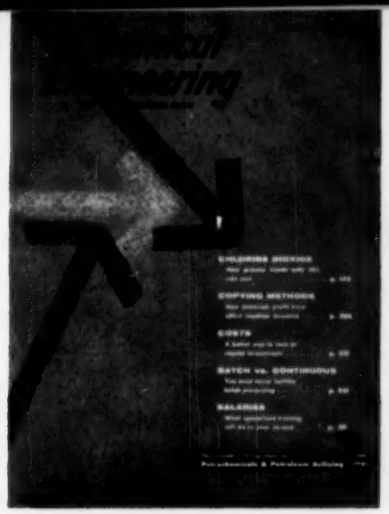
▶ **Ad Sales Manager**—Elton Tuohig; Newark College of Engineering. Engineer for Davis Engineering; ten years as plant engineer and superintendent at Reichhold.

▶ **Circulation Manager**—Paul Erb; Northwestern. Chemical engineer with Du Pont, Culligan, Dorr-Oliver, Portland Cement Assn.; assistant professor at Northwestern.

▶ **Promotion Manager** — Hugh Sharp; Villanova. Engineer with General Chemical, Day & Zimmerman; three years on CE's editorial staff handling *Chementator, YYJ,* process news.

▶ **Editorial**—Our editors, of course, are virtually all chemical engineers. Counting the three who've just joined us, the score now stands at 19 engineers among a total of 22 editors.

Over-all, *Chemical Engineering* has more engineers on its staff than all other chemical process industry technical publications combined!



GUIDED TOUR

Newsworthy developments blossom along the chemical engineering front

Papermaker comes up with a new process that consumes only HCl and electricity to turn out ClO_2 (p. 142). Modelmakers stage a success and bypass blueprints on a construction job (p. 158). New urethane rubber accents durability (p. 170). Modern copying machines spur demand for chemicals needed for papers and developers (p. 206).

What capital investment really is

New concept tells you what should be included in the investment of a project—it's more than the customary cash required for buildings and equipment. Now pick projects with highest returns. (p. 231).

Vital addition to design data

Brand new nomograph extends range of the scanty supply of published working

Chemical

GUIDED TOUR

data and speeds up equilibrium calculations for a wide range of industrially important gas-phase reactions. (p. 235)

Don't write off the batch process

A choice usually has to be made in process design. It's between continuous and batch operation. Both have advantages. Now you'll be better equipped to analyze the economics of each. (p. 241)

New uranium process and its costs

How liquid-liquid extraction is being used to obtain uranium—and how much it costs. Performance data and cost information can be applied to other solvent-extraction processes. (p. 251)

What's special training worth?

Common sense tells us that there ought to be special recognition for special engineering training. Wrong. Two new surveys say that such training doesn't show up in better take-home pay. (p. 311)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order of this issue:

47,103

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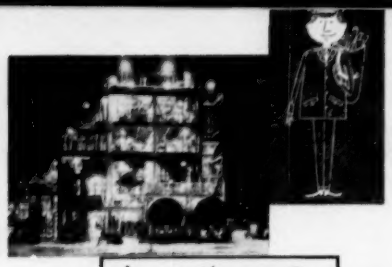

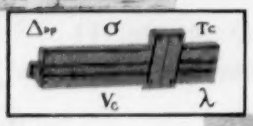

Effective January 1958

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Now you can double your sales calls, sell more, sell faster in the one magazine that reaches and influences the chemical engineer exclusively—wherever he is, whatever he does. Here's how to get, and keep the largest concentrated audience of key chemical engineers in industry on your side of the buying decision twice as often.

INDUSTRY GROWTH INSPIRES IT

In the chemical process industries, an unprecedented rate of growth and technological advance. Most dramatic: *Pharmaceuticals, plastics, petrochemicals.* CHEMICAL ENGINEERING's solid technical coverage of petrochemicals and petroleum refining, for example, was a factor in the discontinuance of Petroleum Processing. By far the preferred engineering magazine in these fields, only CE's broad scope can anticipate and meet their expanding requirements.

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Biweekly frequency means 28% more editorial content, faster communication of engineering techniques, intensified service to readers. Greater emphasis will be placed on growth areas like petrochemicals *while maintaining the broad editorial base* that has made CHEMICAL ENGINEERING—consistently—the 3 to 1 choice among chemical engineers in all industry.

READER INTEREST UP . . . CIRCULATION, TOO

In January (with a new circulation high of 44,000 paid), CHEMICAL ENGINEERING will offer the engineer greater value for his reading minute. The chemical engineer holds many different titles, does many different jobs . . . administration, production and plant operation, design and construction, research and development, sales and purchasing. CE has always been the busy engineer's primary source of product information and of brand preference.

SELL MORE . . . CLOSE SALES FASTER

Recognized by advertisers as the industry's top "sales engineer" . . . this year, as a monthly, CHEMICAL ENGINEERING will carry about 4,500 pages of advertising . . . more than any other magazine serving any part of this market. Now you can reach CE's powerful buying audience with a timeliness and repetition impact never before possible. Wire immediately for complete details.

. . . To sell the engineer, whatever his function

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Chemical Engineering

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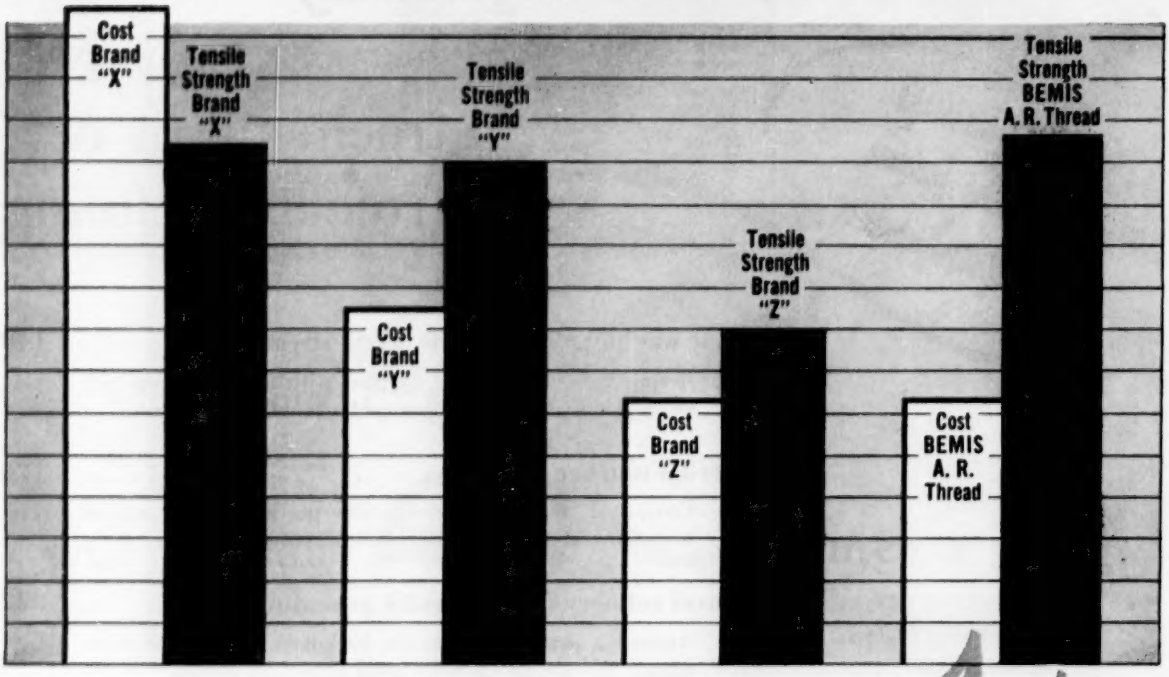
Not only a boon when you're planning new construction, they'll assist you in maintenance work, too.

Report on BEMIS Acid-Resistant Thread:


Cost Brand "X"
Tensile Strength Brand "X"
Cost Brand "Y"
Tensile Strength Brand "Y"
Cost Brand "Z"
Tensile Strength Brand "Z"
Cost BEMIS A. R. Thread
Tensile Strength BEMIS A. R. Thread

LOWEST COST HIGHEST STRENGTH

AFTER SEVERE TEST

When your multiwall bags are made and closed with BEMIS Acid-Resistant Thread you're giving your customers the best packaging — and it costs less

Here's proof of the exceptional value you get from Bemis Multiwalls, made and closed with Bemis Acid-Resistant Thread . . .

An interested, independent, outside organization* conducted rigorous tests with four well-known industrial threads—Bemis Acid-Resistant Thread, a widely used synthetic filament thread, and two other competing threads.

Two samples of each thread were buried in triple superphosphate (0-45-0). One set of samples was placed in a high-humidity room (100°, 90% R. H.) openly exposed. A second set was kept under more normal conditions (73°, 50% R. H.).

After *twelve weeks* in the superphosphate, the samples were removed and tested for tensile strength. Bemis Acid-Resistant Thread and the synthetic filament (long considered to set the top standard) came out with almost exactly the same score . . . and both were substantially ahead of the other two threads.

But here's the payoff—Bemis Acid-Resistant Thread costs *less than half* as much as the only other thread that equalled it in performance. (Incidentally, it performs in sewing machines just like the famous Bemis Special Thread.)

Naturally, you're going to get the best economy, performance *and value* when you use Bemis Multiwalls, made and closed with Bemis Acid-Resistant Thread. And it is *alkali-resistant* as well.

Get the *complete* story from your Bemis man.

** One of the largest U. S. industrial companies.*

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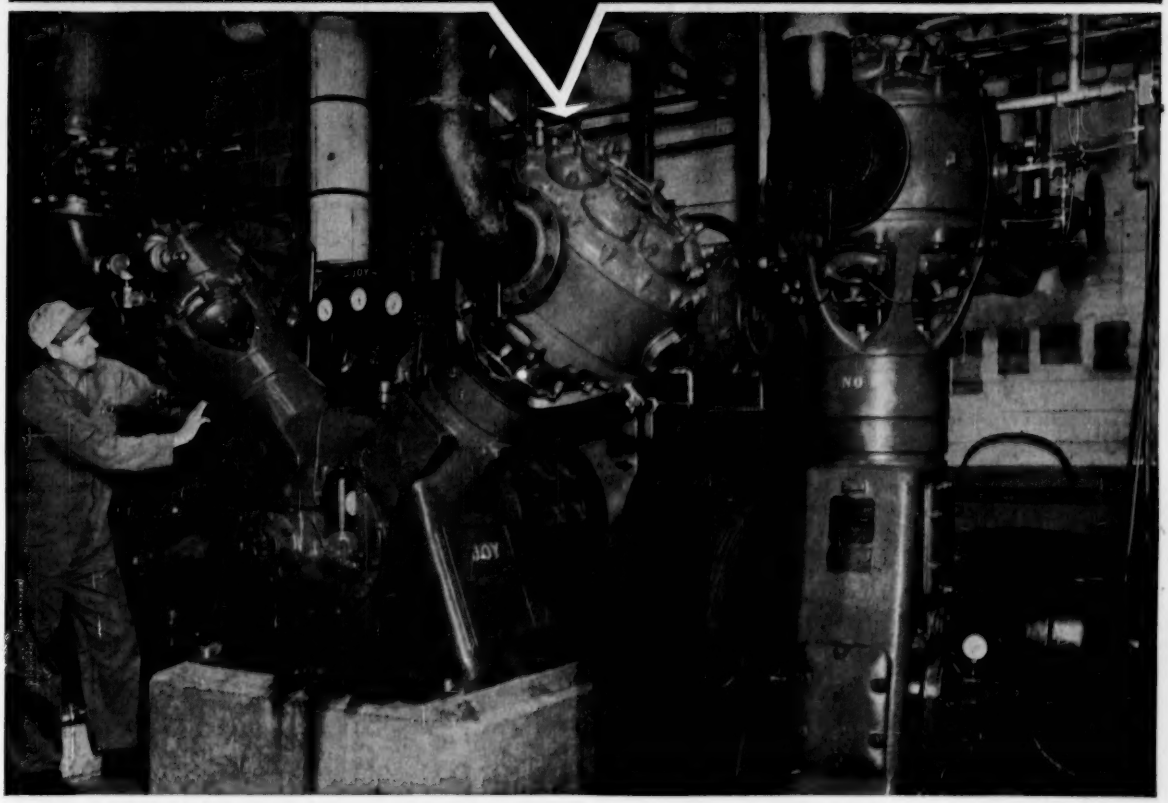

A West Coast Company needed more oil-free compressed air . . . in a hurry! However, there just wasn't any space in the boiler room for additional machines. They had been operating two Joy WG-9 OL vertical compressors (the machine at right in the photo). These non-lubricated compressors had run continously . . . 24 hours a day . . . for *17,000 hours with no down time.*

So they again called Joy in on the problem. The solution: One WG-9 OL with 75 hp was taken out and replaced with a Joy WN-112 E-OL rated at 150 hp. This 974 cfm machine supplies plenty of air for the new equipment, yet is compact enough to fit into the small space available.

If you need oil-free air take advantage of Joy's more than 25 years of experience with non-lubricated compressors. Write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Co. (Canada) Limited, Gal, Ont.*

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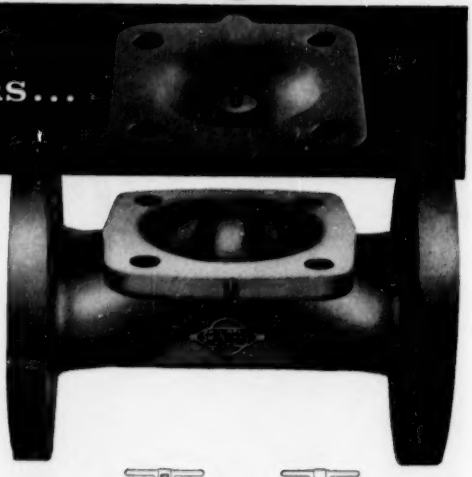
Backing Cushion

with TEFLON Diaphragms...

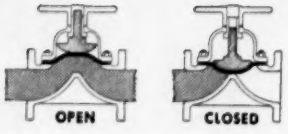


Grinnell Teflon Diaphragms are made by a special process which produces a better product of greater density, toughness and flex life.

The four case histories cited below demonstrate that Teflon offers a very high degree of chemical inertness to some of the most difficult chemicals which industry today must handle. Yet these are only a few of many success stories in the Grinnell files.

Diaphragm life depends on temperature, pressure and frequency of operation. Inquiries must include complete service data to receive prompt and careful attention.

Service Conditions	Saunders Valve Now Used	Service Life: Teflon Diaphragm	Service Life: Previous Valve
Case 1. Benzene hexachloride (30%-40% benzene, free chlorine); 120 to 130 F, 10 to 20 psi; operated 3 to 4 times daily	Glass lined bodies; Teflon Diaphragm; 1 to 3 inches	10 to 14 mos.	1 to 2 mos.
Case 2. 90%-95% HNO_3 plus 1.8% HF (specific gravity 1.62—1.77) 115 F in summer; 40 F in winter; 125 psi; operated 2 to 3 times daily	Durimet 20 body; Teflon Diaphragm; 1 to 3 inches	8 months	2 months
Case 3. AlCl + $_2$ complex; ambient to 220 F; 0-50 psi; operated 1 to 2 times daily	Glass lined bodies; Teflon Diaphragms; 1 to 4 inches	9 months	6 months
Case 4. Sulphuric acid 85%; outside temperature; no pressure; operated 4 times daily	Iron bodies; Teflon Diaphragms; 2½ inches	Still in service after 1 year	3 weeks



Features of Grinnell-Saunders Diaphragm Valves

- Diaphragm lifts high for streamline flow in either direction.
- Resilient diaphragm assures positive, leak-tight closure even with grit or scale in the line.
- Diaphragm absolutely isolates working parts from fluid . . . sticking, clogging, contamination, corrosion eliminated.
- Body, linings and diaphragm materials to suit service conditions.
- Simple maintenance. Diaphragm can be replaced easily without removing valve from the line. No packing glands to demand attention. No metal-to-metal seats to become damaged or wire-drawn.

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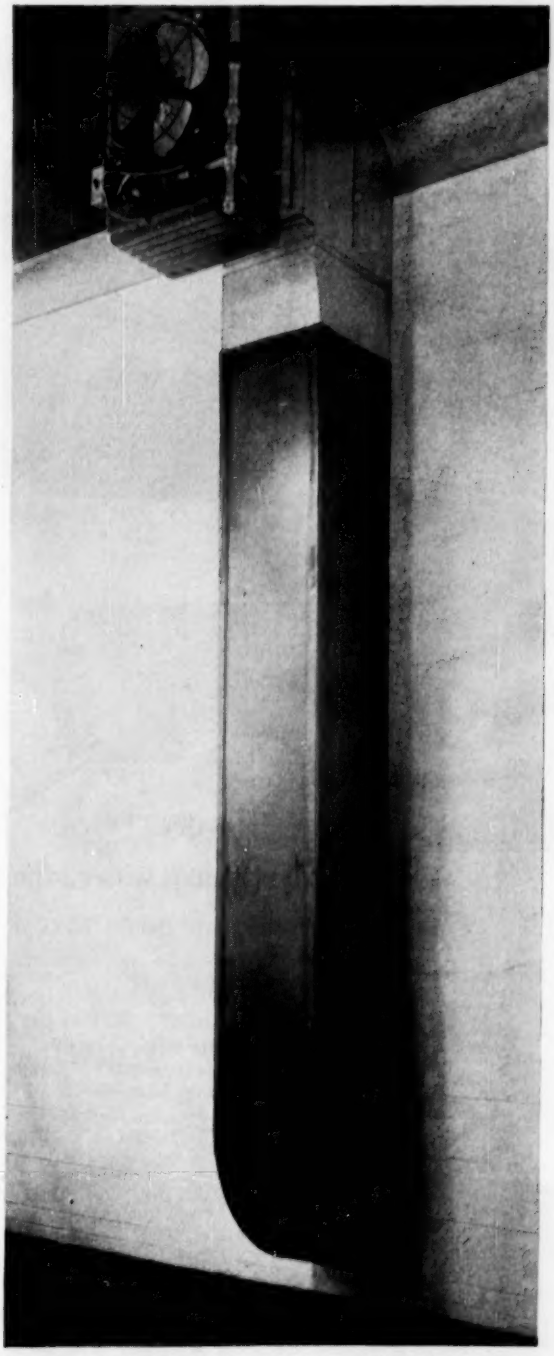
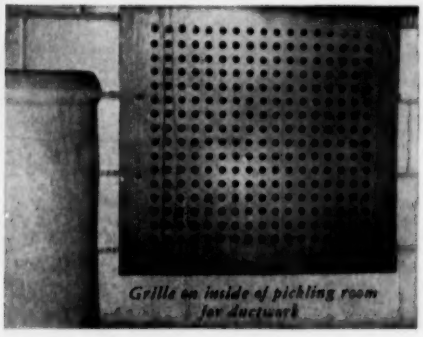
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Another new development using

B.F.Goodrich Chemical *raw materials*



Duct carrying heat for pickling room fabricated by Colonial Plastics Mfg. Co. using rigid vinyl sheeting made from Geon. B.F.Goodrich Chemical Company supplies the Geon polyvinyl material.



Grille on inside of pickling room for ductwork

duct of **GEON RIGID VINYL** withstands acids... outlasts metal

ORDINARY metal duct just can't take nitric, sulphuric and muriatic acid fumes. So a large municipal utility has turned to ductwork made from rigid sheets of Geon polyvinyl materials to heat a water meter pickling room, where these acid fumes are present. The duct replacement problem, due to corrosion, is over.

Besides being acid resistant, this ductwork withstands impact, moisture, and oils. The duct and grille were fabricated with ease—conventional sheet-metal forming machinery was used for shearing, bending and punching; welds were made simply and quickly with solvent cement. The light weight of the rigid vinyl assembly made installation speedy.

Rigid vinyl sheets made of Geon material are available from many manufacturers in large sizes, in a range of gauges, in normal or high impact grades. In many places where there's corrosion, they are ideal for ducts, fans, hoods and fume stacks.

You can get a booklet on properties of rigid Geon materials. Write Dept. FH-8, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.

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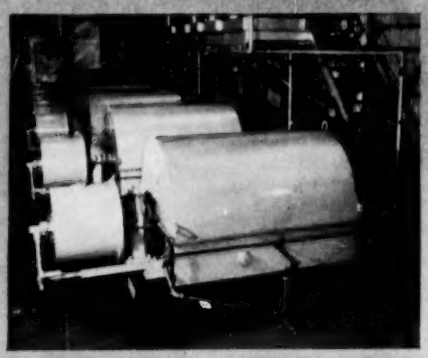
LIQUID VOLUME
FEED CONSISTENCY
PARTICLE SIZE
TEMPERATURE
SOLIDS WASH
LIQUID VOLATILITY
CONTINUOUS FLOW
CAPACITY

it all adds up to this:

The right filtration equipment for you is the one that comes closest to meeting your particular combination of factors.

Based on the experience of hundreds upon hundreds of installations, the one most likely to cover your requirements is the

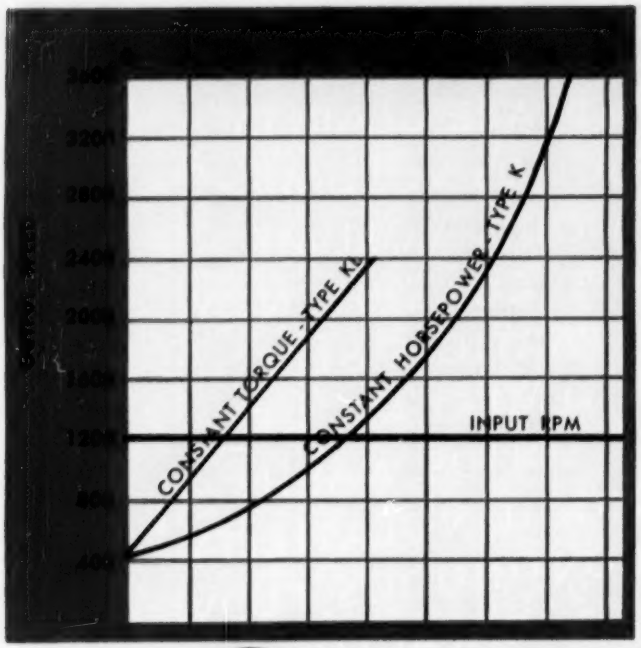


BIRD CONTINUOUS CENTRIFUGAL FILTER

But you don't have to take anybody's word for that. Submit a pilot size sample of *your* feed slurry for actual running test at the Bird Research and Development Center. All factors and all types of filtration will be considered before a recommendation is made. Then, whether it's a Bird Centrifugal Filter or some other type, you'll be absolutely certain of the one best filter for the job *in advance* of your equipment investment.

BIRD

MACHINE COMPANY



Typical speed regulation curves for the Types K and KL Variators. Type KL offers a linear speed regulating pattern, often an advantage in automatic control applications. Output speed regulation of the Type K Variator follows a geometric progression pattern. Starting at the minimum output speed, each turn of the speed regulating wheel produces a fixed percentage increase in output shaft speed.

The Cleveland Speed Variator is available in 18 models ranging from fractional to 16 HP at 1750 input RPM. Unit shown at right, used in process control, has speed regulating worm driven by 75 RPM synchronous motor, with adjusting shaft indicating mechanism modified to actuate limit switches to prevent overtravel.

CLEVELAND SPEED VARIATOR

Accurately Provides Dependable, Infinitely Variable Speed Control

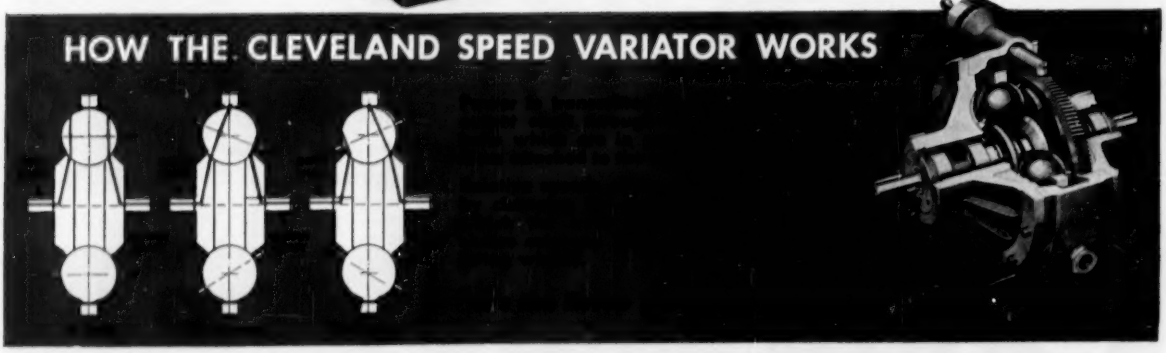
ANNOUNCED late in 1954, the new Cleveland Speed Variator met instant, enthusiastic acceptance. Engineers and designers of industrial equipment already have put thousands of units into use on such varied equipment as cigarette making machines, textile machinery, metalworking machinery, pharmaceutical equipment, transfer tables, conveyors and experimental and testing equipment of many types.

Infinitely variable, the Cleveland Speed Variator gives stepless speed over a full 9:1 range—from ⅓ to 3 times input speed. Output speed can be adjusted by either a hand wheel on the Variator or by manual or automatic remote control.

The Cleveland Speed Variator offers these major advantages:

1. An extremely compact unit with input and output shafts in line and rotating in the same direction.
2. Almost any input speed up to 1800 RPM can be used—either clockwise or counterclockwise rotation.
3. Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant output torque over a 6:1 range.
4. Speeds infinitely variable over entire range of adjustment.
5. No slippage—positive torque response mechanism adjusts in direct proportion to the loads encountered.
6. Long life and minimum maintenance due to absence of belts or complicated linkages.
7. Ample bearing support for overhung pulleys on both input and output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.



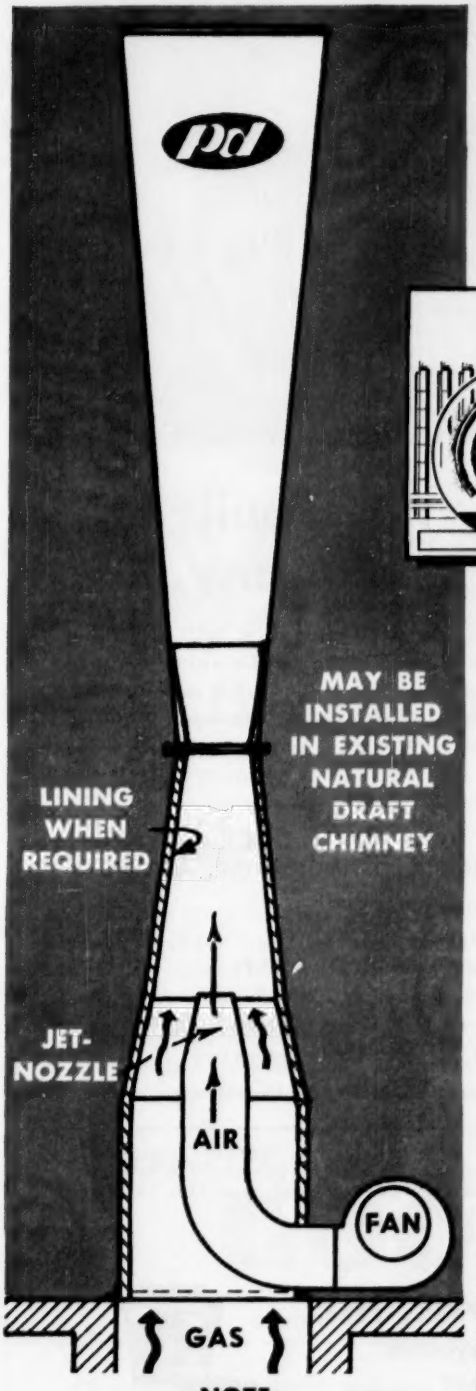
THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3275 East 80th Street, Cleveland 4, Ohio

Sales Representatives in all major industrial markets • In Canada: Peacock Brothers Limited.

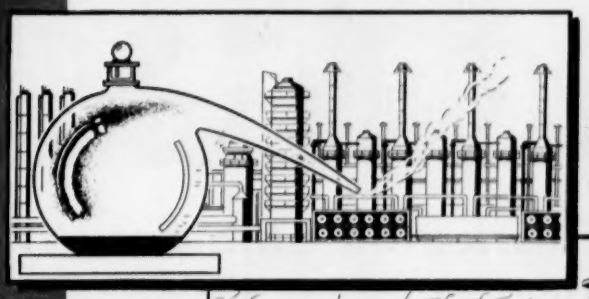
CORROSIVE or 2000° GAS!

PRAT-DANIEL CAN HANDLE IT FOR YOU



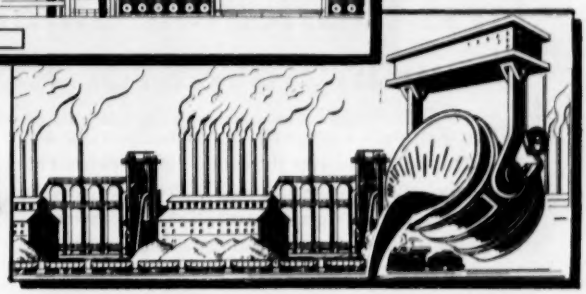
NOTE:
THE FAN HANDLES CLEAN AIR ONLY. WILL LAST INDEFINITELY.

If your problem is to convey or evacuate erosive, corrosive, explosive or high temperature gas, an OUT-OF-CIRCUIT PD FAN AND EJECTOR STACK is your answer. Large or small gas volume. Can be designed small enough for hoods over fuming kettles or for handling huge quantities of gas at steel works. Vertical or horizonal flow — any type of fume or gas at any temperature. Frequently used to boost drafts in existing installations. Get the facts. You may save many dollars in maintenance costs.



FOR CHEMICAL PLANTS

FOR STEEL MILLS



Experience of more than 30 years is behind this effective design. Prat-Daniel Corporation engineers' know-how is backed by many installations made in the chemical, steel and munitions industries. The units can be constructed of carbon steel (brick lined if necessary), stainless, plastic coated or lead lined steel, aluminum, or other materials to suit your needs. Good furnace design usually calls for a PD ejector type stack.

Project Engineers

THE THERMIX CORPORATION

P. O. BOX 1189, GREENWICH, CONN.

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Que.

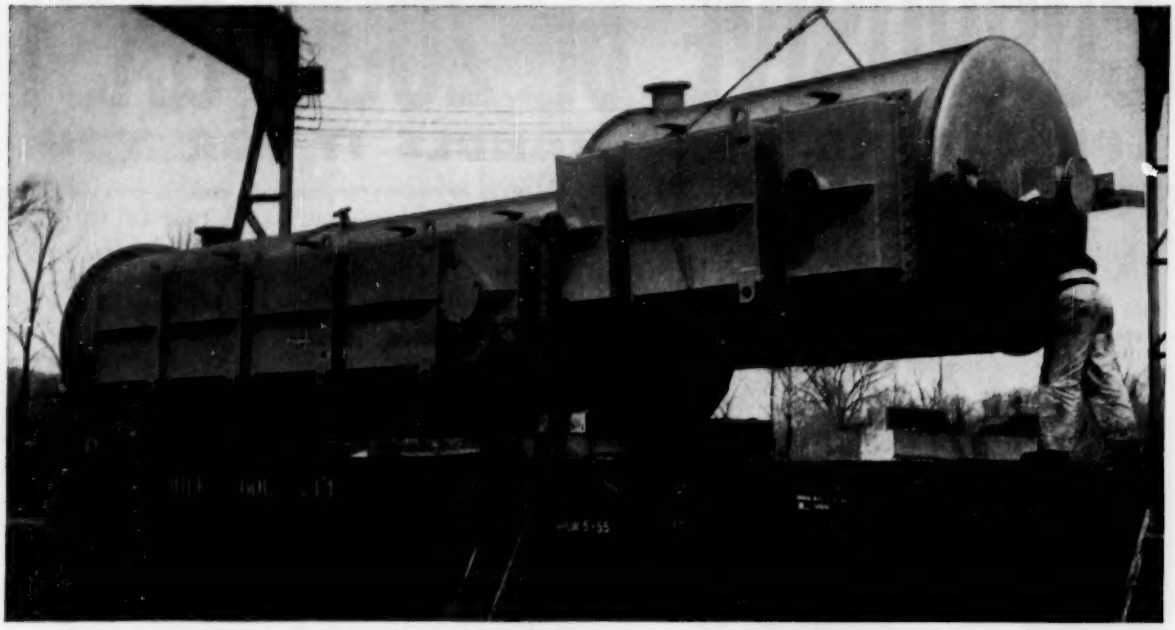
Designers and Manufacturers

PRAT-DANIEL CORP.

SOUTH NORWALK, CONN.

POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

THE THERMIX CORP. P. O. Box 1189-6
Greenwich, Conn.
Gentlemen: Please send me Prat-Daniel Bulletin A572
Name: ..... Title: .....
Company: .....
Street: .....
City: ..... State: .....



First fabricated ammonia still...built at Downingtown for Koppers Company, Inc.

When Koppers Company, Inc., Engineering and Construction Division designed this welded carbon steel plate ammonia still to replace its previous cast iron design, it naturally chose the fabricator with care. Close tolerances were required on positioning of risers, riser slots, bells, trays and weirs. We're proud of the part Downingtown had in this pioneering effort. This still is used for stripping the ammonia from ammonia liquor produced in a chemical recovery coke plant.

THE UNIT WAS BUILT TO THE FOLLOWING SPECIFICATIONS:

Inside Diameter: 7'0"
Over-All Height: 37'10"
Design Data: 12 psi, 650° F.
Operating Data: 7 psi, 250° F.
Shop Test: 12 psi hydrostatic for 90 min.
Total Weight: 60,000 pounds

Send for bulletins describing our experience and facilities.

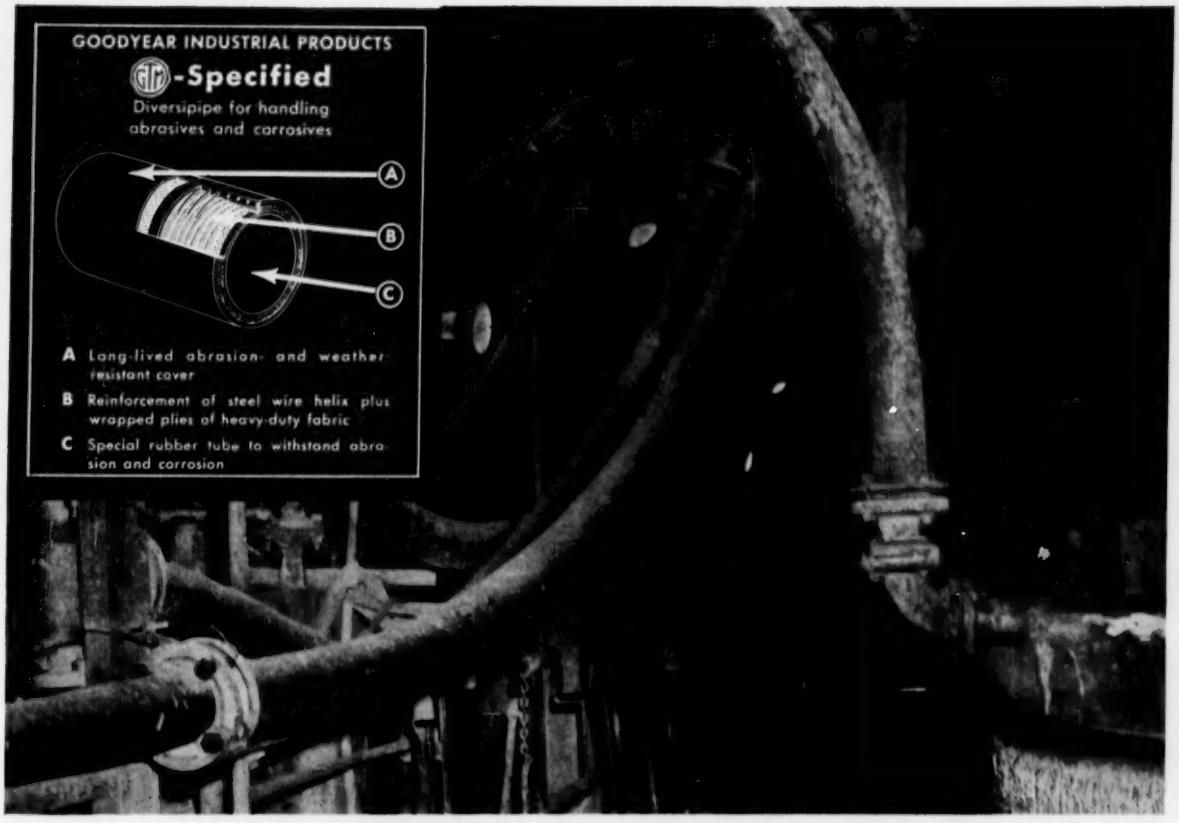
◀ Interior of bottom section, showing position of rectangular bells fabricated from stainless steel, type 410. Thirteen trays, with bells.

Downingtown Iron Works, Inc.

140 Wallace Ave., Downingtown, Pennsylvania

division of PRESSED STEEL TANK COMPANY Milwaukee
Branch offices in principal cities

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS


GOODYEAR INDUSTRIAL PRODUCTS
G.T.M.-Specified
Diversipipe for handling abrasives and corrosives
A
B
C
A Long-lived abrasion- and weather-resistant cover
B Reinforcement of steel wire helix plus wrapped plies of heavy-duty fabric
C Special rubber tube to withstand abrasion and corrosion

Lifesaver for industrial life lines

A HIGHLY abrasive, highly corrosive slurry—phosphate rock in sulfuric acid—was just plain murder on the complex life lines at this Southwestern fertilizer plant. They knew the stoutest steel pipe couldn't handle it. Heavy iron pipe costs too much—would have to be dismantled for cleaning should clogging occur. And the special acid hose they tried *failed in two to three months.*

Then a lifesaving recommendation was made by the G.T.M.—Goodyear Technical Man—Diversipipe—the husky, flexible rubber pipe designed for just such rugged jobs. It's easily unclogged by flexing. *It lasts up to two years. And it's worked so well that 15,000 feet are now in use at this one plant.*

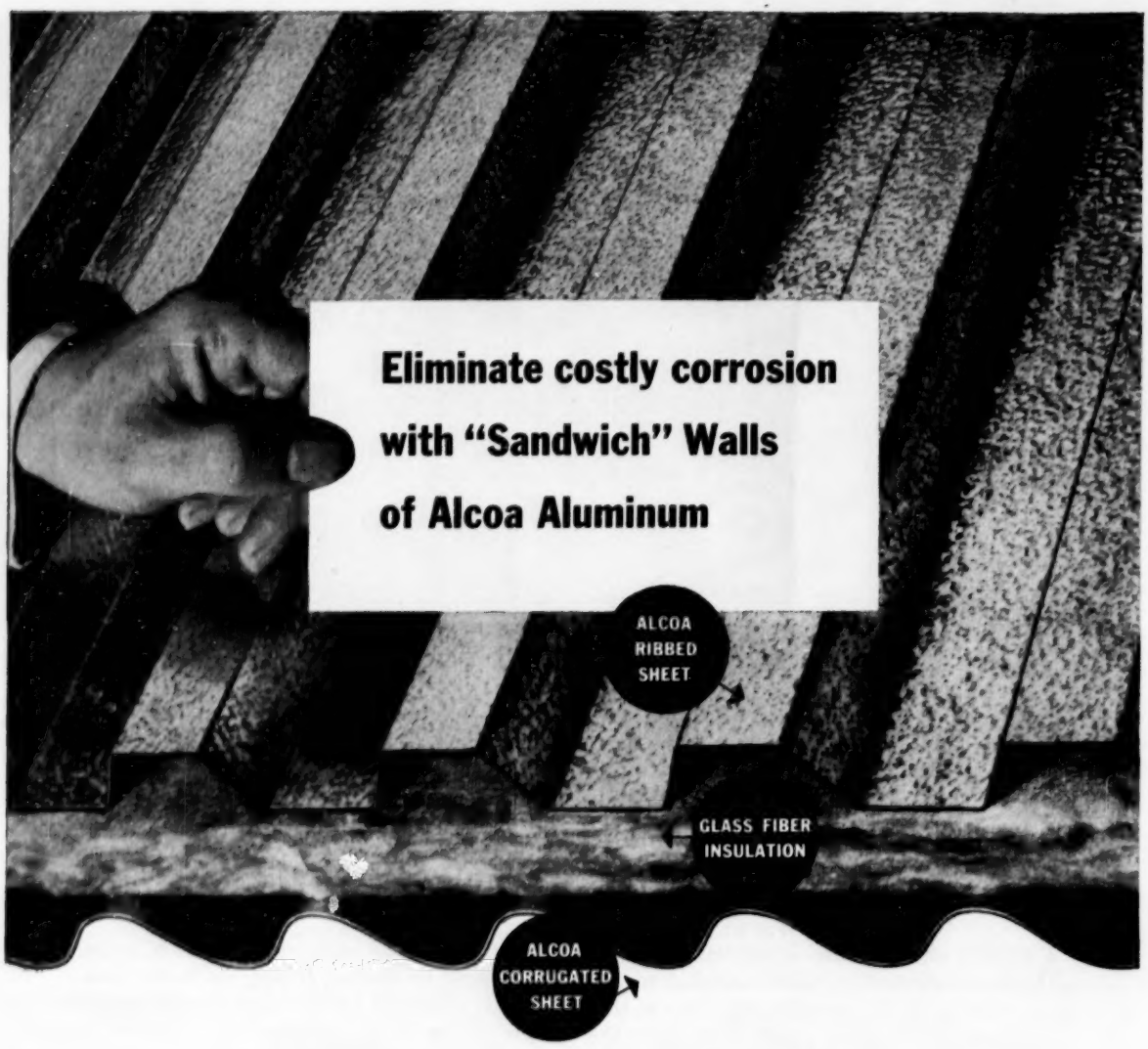
If your plant has a life line problem—caused by corrosive or abrasive materials or a murderous combination of both—the G.T.M. is your man. He can specify hundreds of kinds of hose—all designed to save you time and money. And you can contact him through your Goodyear Distributor or by writing Goodyear, Industrial Products Division, Akron 16, Ohio.

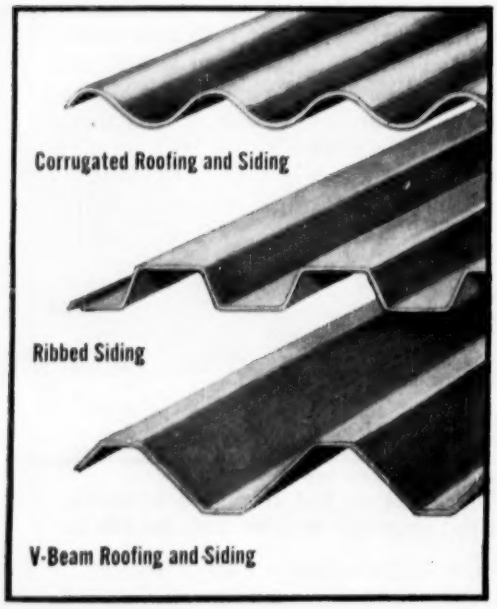
DIVERSIPIPE by

GOODYEAR

THE GREATEST NAME IN RUBBER

IT'S SMART TO DO BUSINESS *with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."*


Eliminate costly corrosion with "Sandwich" Walls of Alcoa Aluminum
ALCOA RIBBED SHEET
GLASS FIBER INSULATION
ALCOA CORRUGATED SHEET



Wherever corrosion is a problem, Alcoa® Aluminum Building Products have proved unequaled in reducing construction and maintenance costs . . . especially in the chemical industry.

For instance, with sandwich walls of Alcoa Aluminum you gain the advantage of the lowest cost, insulated metal wall system known. Construction costs are lower because these walls fabricate quickly, go up fast with less manpower. And maintenance is no problem. You'll find, too, that sandwich walls of Alcoa Aluminum have three times the insulating value of an eight-inch masonry wall.

Alcoa Aluminum Industrial Building Products offer three types of roofing and siding for uninsulated buildings. These come in an attractive variety of finishes and offer the same low-cost, maintenance-free advantages. First cost is the *last cost* with aluminum.

For more information, contact your nearest Alcoa sales office and be put in touch with an Alcoa Approved Applicator. Or write Aluminum Company of America, 856-L Alcoa Building, Pittsburgh 19, Pennsylvania.

Your Guide to the Best in Aluminum Value

NEW! "ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

ALCOA ALUMINUM
INDUSTRIAL BUILDING PRODUCTS

Assembly is simple

with bucket elevators LINK-BELT-built from head to boot

CHAINS, SPROCKETS, PULLEYS — a type and size to handle all kinds of material, satisfy any application requirement.

BEARINGS — We make all types — babbitted, bronze, ball and roller — to meet your specific service conditions.

CASINGS—are furnished weather- or dust-tight. They are self-supporting —where conditions warrant, lateral tie-in can be supplied.

ENCLOSED GEAR DRIVES — Gearmotors, Motogears, Worm Gear Drives — in sizes and ratios to meet any requirement.

BUCKETS—All types and sizes suitable for handling a variety of materials are available from stock.

TAKEUPS—A type suitable for adjusting elevator chain or belt to proper tension — babbitted, bronze, ball and roller bearing types.

All components are designed and manufactured for quick installation, smooth performance

HERE's a point worth considering when you review prices on bucket elevators. Installation costs have a big effect on the total outlay. And your best bet for holding field erection costs to a minimum is by relying on Link-Belt.

Reasons are: first, Link-Belt *manufactures all bucket elevator components*—your assurance that designs are related. Secondly, it's easy to select the proper bucket elevator to meet your specific requirements from Link-Belt's complete line. And third, with each Link-Belt bucket elevator you get built-in alignment.

In addition, Link-Belt will erect your elevator and accept full installation responsibility. For more details and assistance in selecting a suitable bucket elevator for your operation, call your nearby Link-Belt office today.

14,719

Designed for maximum elevating efficiency...

◀ **FRAGILE MATERIALS** — pellets, granules, etc. — are handled gently by internal discharge elevators. Offers high capacity at slow speeds.

FOR FREE-FLOWING, FINE AND LOOSE materials with small to medium lumps— specify centrifugal discharge bucket elevators. ▶

LINK-BELT

BUCKET ELEVATORS

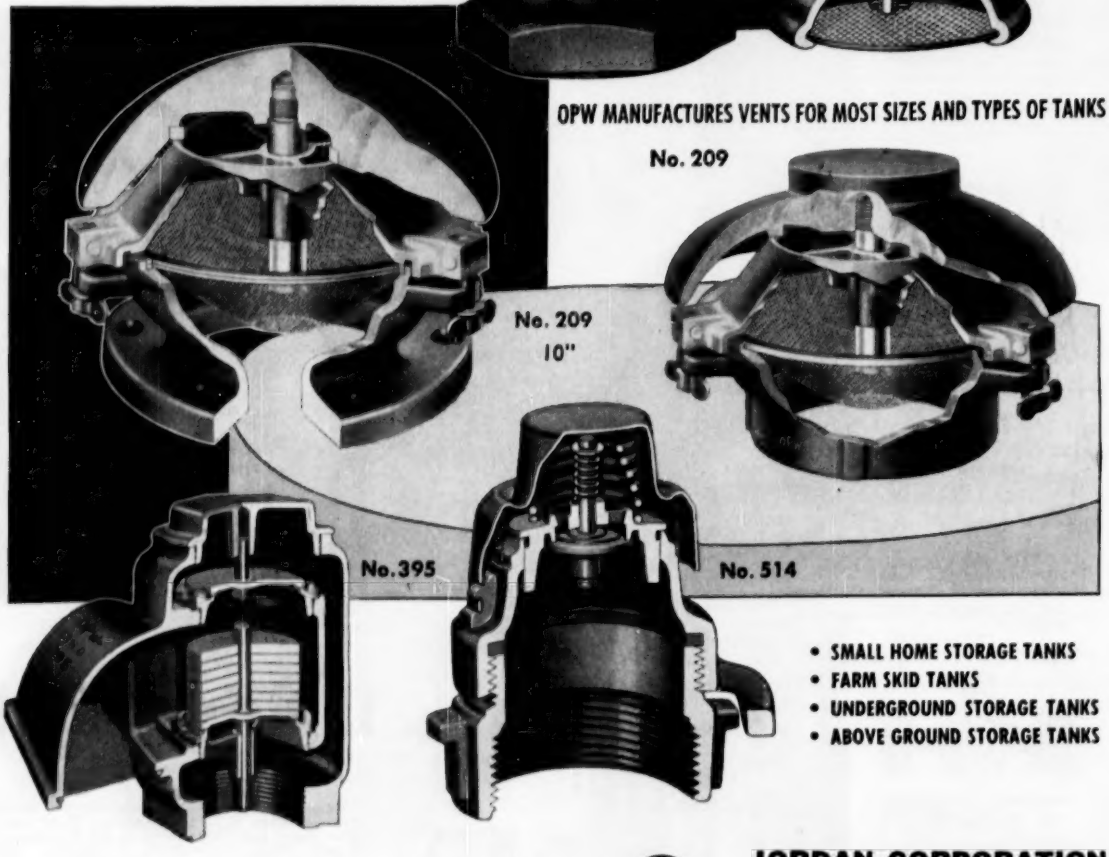
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

Prevent costly vapor loss with pressurized

OPW tank vents

There's a vapor saving OPW Tank Vent for every purpose. Precision machined, product engineered for lifetime use, they are your INVESTMENT against vapor loss due to product expansion and temperature variation. Weighted to specifications, OPW Tank Vents trap and hold vapors and release only at set pressures, insuring maximum protection and dollar dividends. Double mesh screen readily accessible for inspection maintains bulk storage safety.

OPW MANUFACTURES VENTS FOR MOST SIZES AND TYPES OF TANKS



- SMALL HOME STORAGE TANKS
- FARM SKID TANKS
- UNDERGROUND STORAGE TANKS
- ABOVE GROUND STORAGE TANKS

Send for the OPW Tank Venting and Emergency Relief Recommendation Chart!

JORDAN CORPORATION
6013 WIEHE ROAD
CINCINNATI 13, OHIO
ELmhurst 1-1352

B.F.Goodrich

Koroseal plumbing for an acid bath

THAT tank contains corrosive sulfuric acid. It's used as a bath for cleaning wire and brass at Bristol Brass Corporation, Bristol, Connecticut. Other tanks contain bichromate and soap solutions.

A siphon method was formerly used to empty these tanks. Looking for a simpler, more efficient means of handling the job, Bristol engineers decided to install drainage pipe of Koroseal rigid polyvinyl chloride. Koroseal pipe was also installed to handle overflow.

Ask Bristol engineers about their experience with this Koroseal installation and they'll tell you how Koroseal PVC increased production, saved time and labor, cut maintenance problems, made possible a much cleaner operation, eliminated spillage and thus reduced acid consumption.

Koroseal PVC pipe is widely used in industry for carrying acids. Koroseal is equally inert to caustics, oils, greases, salts and most industrial chemicals. It lasts indefinitely without deterioration. Rodents will not harm it. Weather and sunlight will not affect it. Because it does not give off any odor or taste, Koroseal also is often used to carry water as well as chemicals.

Koroseal is very light—may be had in the form of pipe, pipe fittings, rods or sheet. It is readily threaded, drilled or sawed. It may be glued or welded together. In short, Koroseal is one of the most versatile, easy to handle materials used by industry today.

For further information on B. F. Goodrich rigid Koroseal PVC simply mail in the handy coupon.

B.F.Goodrich

INDUSTRIAL PRODUCTS CO.

B.F.Goodrich Industrial Products Co.
Dept. CE-11
Marietta, Ohio

Please send me free booklets on:

☐ Rigid Koroseal Pipe
☐ Rigid Koroseal Sheet

Name_____

Address_____

Company_____

City_____ **Zone** **State**_____

Koroseal—T. M. Reg. U. S. Pat. Off.

No. 4 of a series

"I've found continuous pure air:

Kathabar® systems kill over 97% of micro-organisms in large volumes of air!"

Because bacteria are killed by the chemical absorbent in a Kathabar system, it was long suspected that air passed through this system should be relatively free of bacteria. Proof of this theory would be of vital importance wherever airborne organisms contaminate humans or products.

To check this hunch, Surface asked a university research staff to conduct a series of exhaustive tests.

research proof

The conclusion of the research staff is that 97% of all micro-organisms (both pathogenic and non-pathogenic) are removed from air which passes through a standard Kathabar unit.

More tests are being continued in several industries with varying conditions. For example, one project is underway to test the Kathabar system's effectiveness in hospital operating rooms; and another in brewery fermentation cellars.

what does it mean?

Current research results indicate that air purification—long desired by many industries and institutions—can be as feasible and simple as purification of drinking water.

The system's advantages for hospitals show the significance of these findings. It provides the first continuous source of pure air. The liquid sorbent is not affected by the organisms it kills. Neither is it affected by intermittent minor dilution. It is equally effective with any volume of air you require.

The system also provides practical, year-round humidity control. It will humidify in the winter; dehumidify in the summer.

dry, clean coils

Where refrigeration is included in a Kathabar system, coils are kept dry and clean—eliminating a favorable breeding spot for bacteria and molds.

Further advantages of the system seem apparent. For example, it may permit recirculation of air for operating, delivery, cystoscopic, and fracture rooms. Eliminating the need for all-fresh air would reduce both the first cost and operating cost of a Kathabar air conditioning system.

benefits for other industries

Hospitals, of course, are not alone in their need for continuous pure air. Direct and immediate benefits can be realized in other fields, too, such as foods, pharmaceuticals, beverages, clinics, laboratories, and public buildings.

Even where pure air is not a primary factor, it is an important added benefit. Examples are drying operations, storage, testing, comfort applications.

who uses Kathabar systems

Kathabar systems make profits out of air for these industries:

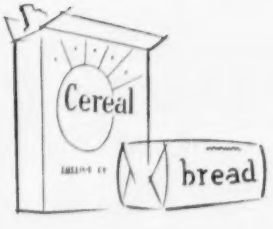
Atomic Energy	Machining
Breweries	Matches
Cake Mix	Marine
Candy	Meat
Cellophane	Offices
Cellulose	Ordnance
Cereals	Paper
Chemicals	Pharmaceuticals
Coffee	Plastics
Comfort	Printing
Compressors	Rockets
Cookies	Rubber
Electronics	Shellac
Explosives	Sugar
Film	Sanitaryware
Foundries	Testing
Gelatin	Textiles
Glass	Transformers
Glue	Transistors
Gum	Vacuum Tubes
Hospitals	Varnish
Hotels	Waterworks
Lacquer	Wire
Lenses	Yeast

how they use Kathabar systems

Many of these industries are now discovering the benefits of air sterilization by Kathabar systems. Others use them to (1) maintain spaces at 80 F and 55% RH or lower; (2) obtain continuous air at sub-freezing dry bulbs and dew points; (3) eliminate condensation; and (4) improve drying processes.

send description of your problem

Air Conditioning and Drying Division
SURFACE COMBUSTION CORPORATION
2380 Dorr Street Toledo 1, Ohio

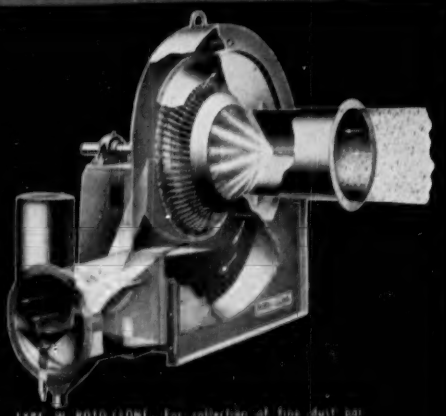


Kathabar systems by Surface

SOAP DUST
LIME
SILICATE PIGMENT
POLYVINYL CHLORIDE
SODIUM CHROMATE
SODIUM BICARBONATE
DICALCIUM PHOSPHATE
CITRIC ACID
POTASSIUM CARBONATE
BARIUM OXIDE
SODIUM FORMATE
BORIC POWDER
AMMONIUM NITRATE
ALUMINA HYDRATE
CARBON DUST

AMERjet—For collection of the very finest particles and particles that must be recovered dry

CRYSTALLINE DUST
PHOSPHATE DUST
LEAD OXIDE
STARCH DUST
TITANIUM DIOXIDE
ALUMINUM OXIDE
PIGMENTS
CAUSTIC VAPORS
CARBON DUST
LEAD STEARATE
CLAY
BARIUM SULFIDE



TYPE W ROTO-CLONE—For collection of fine dust particles in moderate concentrations

TRIPLE TROUBLE

CUPRIC OXIDE
CALCIUM SULFATE
ALUMINA
CARBON BLACK
INSECTICIDES
AZO DYE
VOLCANIC ASH
FUNGICIDE POWDER
FERTILIZER DUST
GLYCERIN VAPOR
PLASTICS
HERMICULITE DUST
LIME
ALUMINUM POWDER
PHOSPHATES
BARIUM CARBONATE

TYPE N ROTO-CLONE—For collection of heavy dust loadings of all particle sizes

SULPHURIC ACID MIST
ZINC STEARATE
SODIUM CITRATE
BARIUM SULFATE
ALUMINUM SILICATE
T.N.T.
SODIUM SILICATE
AMMONIUM SULFATE
METALLIC OXIDES
BAUXITE
PIGMENTS
PHENOLIC RESINS

FOR DUST!

THESE AAF UNITS DO MANY JOBS FOR CHEMICAL PROCESSORS

The materials at left are but a smattering of the hundreds being efficiently and economically collected for the chemical industry by AAF's AMERjet and wet-collecting ROTO-CLONES.

All three units offer these four basic design features: (1) small space requirements, (2) maintained performance over a wide range of operating conditions, (3) constant exhaust volume, and (4) high collection efficiency.

For more complete information on any or all of these units, call your local AAF representative or write direct for Type W ROTO-CLONE Bulletin 272B; Type N ROTO-CLONE Bulletin 277; AMERjet Bulletin 279.

AAF Dust Control Equipment

Illinois Heating Specialties

AAF

herman nelson

American Air Filter
COMPANY, INC.

403 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

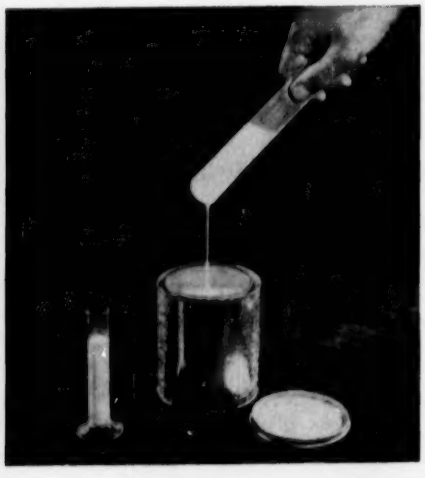
— BETTER AIR IS OUR BUSINESS —

AAF Filters and Precipitators

Heating and Ventilating Units

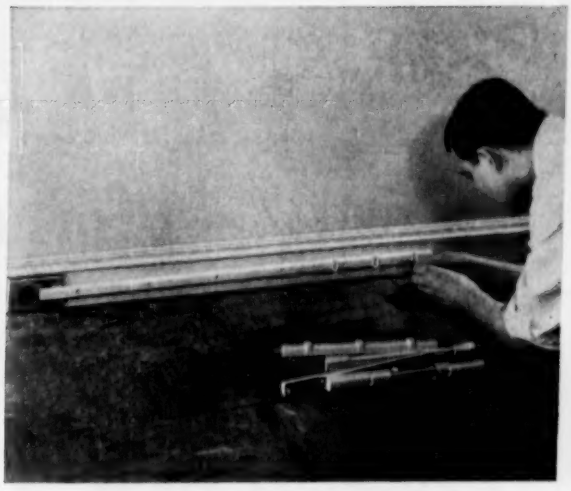
Life on the Chemical Newsfront

FIFTY PUREBRED HEIFERS are offered in a current Cyanamid program to help improve the nation's dairy herds. Any dairy farmer can participate and if he is one of the winners he will receive a calf of his own breed choice. The program, which ends January 31, 1958, is part of a promotion for AUREOMYCIN® *chlortetracycline* mastitis treatment—an important factor in maintaining dairy herd health. This is one of many chemicals and drugs offered for farm and home use by Cyanamid's recently formed Farm and Home Division.



FREEZE-THAW STABILITY IS ADDED to vinyl latices prepared with PAM *polyacrylamide* as the protective colloid. A water-soluble polymer, PAM protects latex particle size and dispersion through multiple freeze-thaw cycles, keeps viscosity stable through a range of application conditions and provides excellent salt tolerance where required. The improved storage characteristics of dispersions stabilized with PAM will mean wider application possibilities for paints, adhesives and other vinyl latex products. **(New Product Development Department, Dept. B)**

RED PIGMENTS NOW STAY RED in vinyl floor tile in spite of exposure to acids, alkalis and harsh cleaning methods. The pigment is Clarion Red 20-7150, a vivid red "on the yellow side" that was particularly designed to withstand the attack of household chemicals. As a result, Clarion Red 20-7150 is finding application in a wide range of plastic products where bright permanent reds are called for. **(Pigments Division)**



RELIEF FROM THE "WIRE JUNGLE" is provided by the new Snapit Inter-Link system made by Cable Electric Products Inc. Molded of BEETLE® *urea molding compound*, these interlocking units provide low-cost, easily installed electrical outlets that have Underwriters Laboratories' approval and meet building codes. The strength and excellent insulating properties of BEETLE assure safe, dependable service. **(Plastics and Resins Division)**

SOUR NAPHTHAS NOW YIELD HIGH-TEST GASOLINE as hydrogen processing, with the aid of Cyanamid's new AERO® HDS-2 *cobalt-molybdena catalysts*, salvages high-sulfur stocks that can't be reformed directly. The sulfur, which poisons the platinum catalyst used in reforming, is effectively converted to hydrogen sulfide gas, which is easily removed, and the stock becomes ideal reformer feed in the production of high-octane fractions. Practical operating experience was combined with laboratory development in designing these HDS hydrogen desulfurization catalysts and they are now being produced at a new Cyanamid catalyst plant. **(Industrial Chemicals Div., Dept. B)**

®Trademark

CYANAMID

AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Helping America Make Better Use of Its Resources

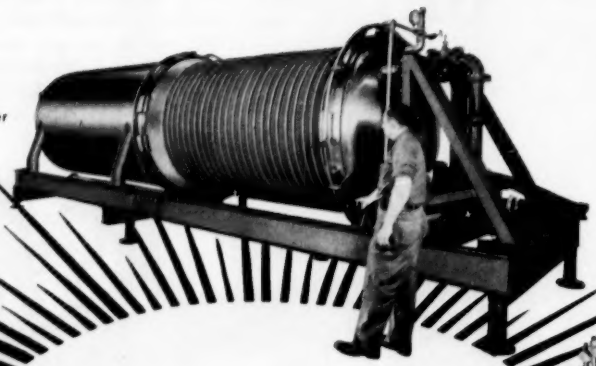
1907 50 1957

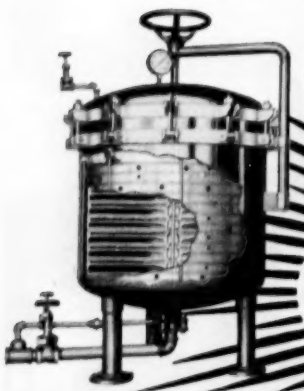
For further information on these and other chemicals, call, write or wire American Cyanamid Company

We're looking for you at... BOOTH 56

CHEMICAL SHOW . . . New York . . . DEC. 2-6

Model MCR
With Speed-Lock Cover
Heavy Duty

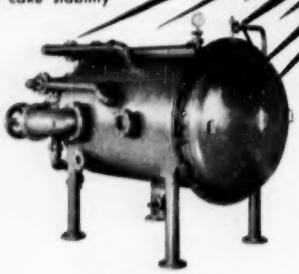




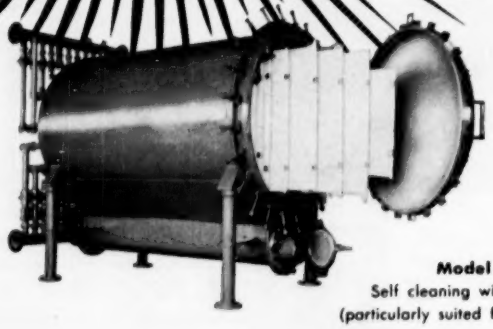
Horizontal Plate Filter
positive cake stability

SPARKLER FILTERS

Model VR
Disc plate trap filter



Model SCJ
Heavy duty water filter



Model RSC
Self cleaning without opening
(particularly suited for toxic products)

See these filters at the show

SPARKLER MANUFACTURING COMPANY, Mundelein, Illinois

FILTRATION ENGINEERING AND MANUFACTURING FOR OVER 30 YEARS.

KELLEY

SERVING THE NUCLEAR INDUSTRIES

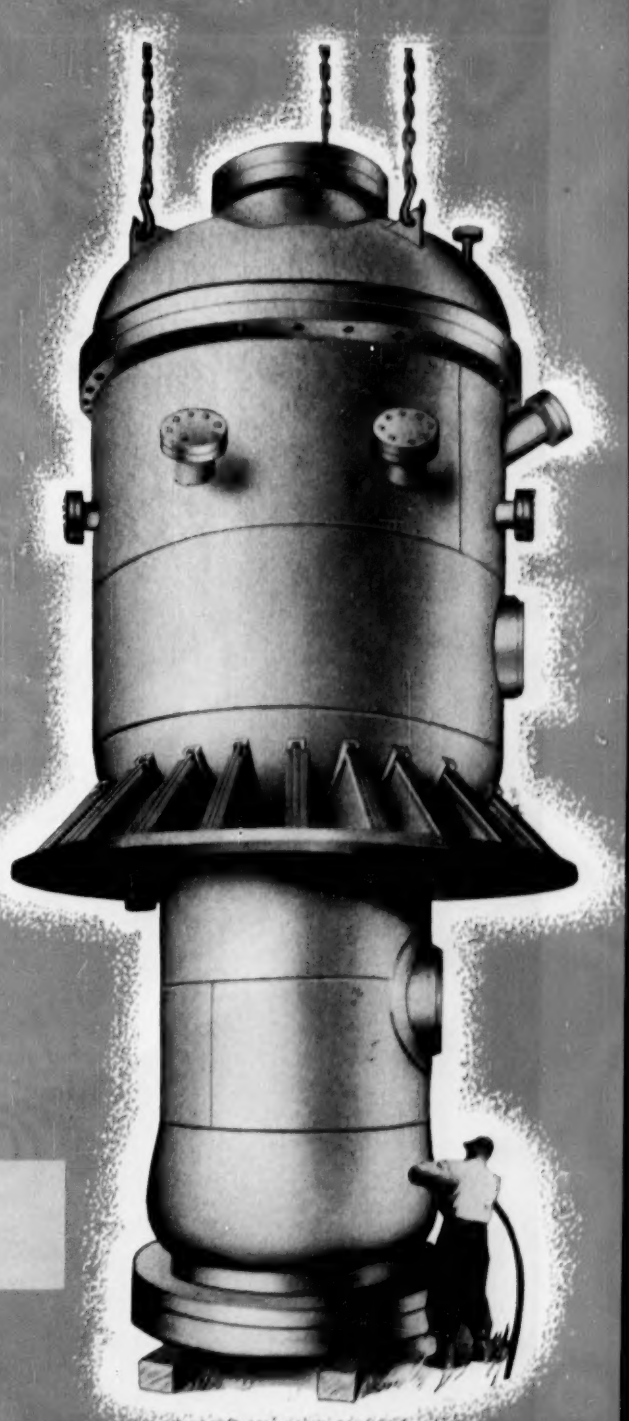
IN THE FIELD OF RADIATION SHIELDING... WE HAVE SERVED INDUSTRY FOR OVER 35 YEARS

RADIATION SHIELDING IS OUR SPECIALTY...

Manufactured and Installed to suit the specific requirements of...

- **ATOMIC ENERGY**
- **NUCLEAR INDUSTRIES**
- **HOT LABORATORIES**
- **INDUSTRIAL X-RAY ROOMS**
- **BIOLOGICAL LABORATORIES**

Stainless steel equipment of intricate design, fabricated to precise tolerances. Years of experience in the A. E. C. field enables us to meet your most rigid requirements...



.... ETR recently built by O. G. Kelley & Company for the A. E. C. installation, Scoville, Idaho.

O. G. KELLEY and Company

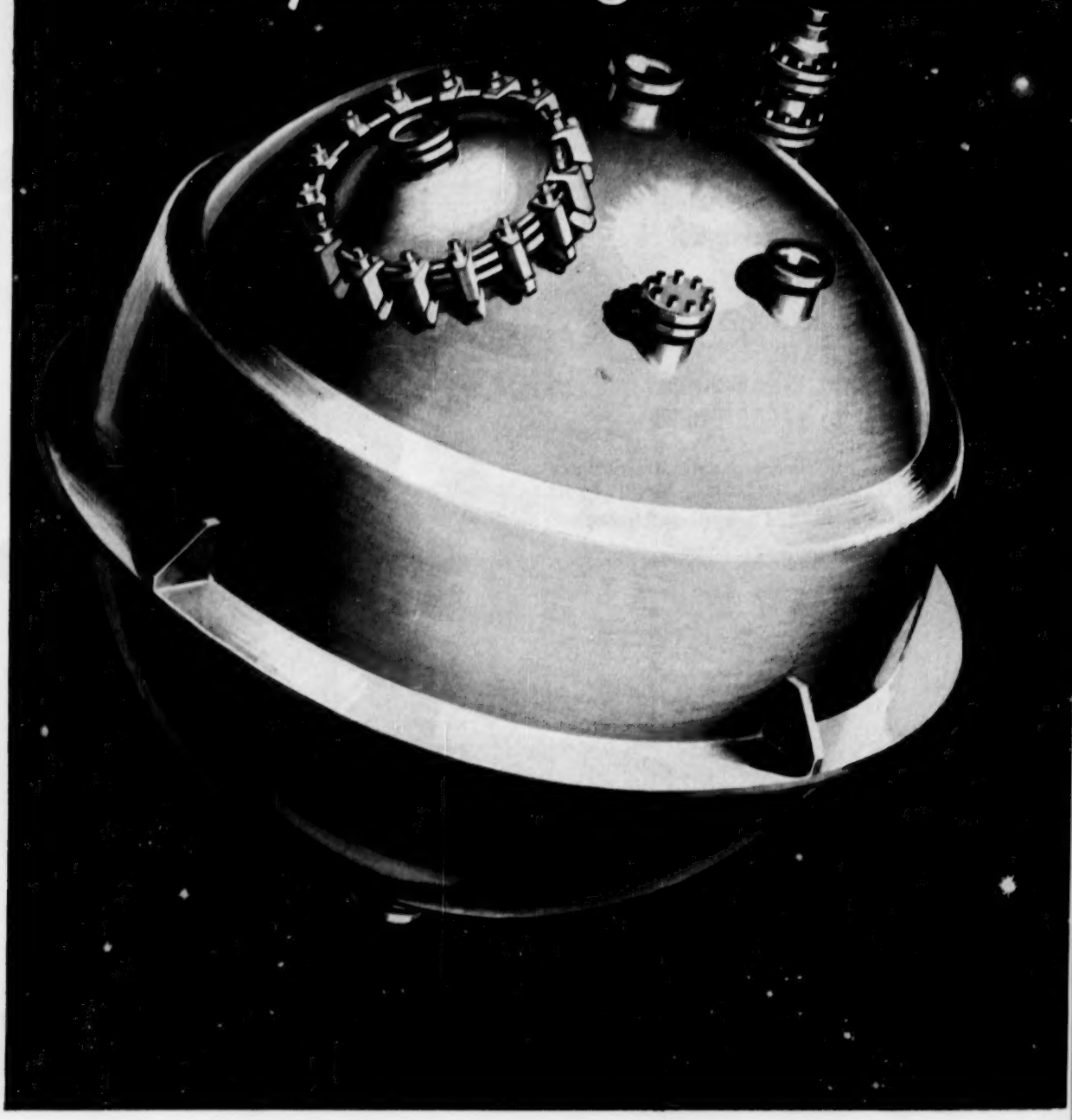
ENGINEERS DESIGNERS FABRICATORS

BOSTON 22, MASSACHUSETTS

JOHNSON CITY, TENN. ELIZABETH, N. J. CLEVELAND, OHIO NEW YORK, N. Y. PITTSBURGH, PA.

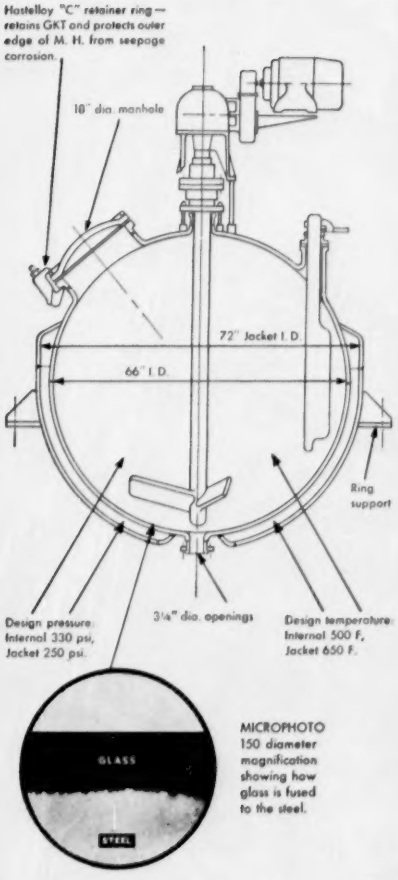
TOMORROW'S ENGINEERING TODAY!

the spherical glass-lined



reactor is here!

Designed to operate at internal pressures in excess of 300 psi


Hastelloy "C" retainer ring — retains GKT and protects outer edge of M. H. from seepage corrosion.
18" dia. manhole
72" Jacket I. D.
66" I. D.
Ring support
Design pressure: Internal 330 psi, Jacket 250 psi.
3¼" dia. openings
Design temperature: Internal 500 F, Jacket 650 F.

MICROPHOTO 150 diameter magnification showing how glass is fused to the steel.

A Glascote first!

No longer need processing be limited to 200 psi! This is the kind of process engineering you'd expect from Glascote. The 500-gallon (nom. capacity) reactor shown is designed to operate at 330 psi internal pressure and 250 psi in the jacket.

- Large capacity — sphere shape permits thinnest metal wall possible to contain a given amount of liquid under pressure.
- Shorter agitator shaft — reduces drive maintenance, shaft bending normally encountered in large volumes.
- One main seam — minimum of welding. Full X-ray quality. Ring-type support.
- Higher vaporization rates — less foaming, due to larger liquid surface area.
- Higher pressures — both internal and external for larger units.

And . . . like all Glascote products, you benefit from 100% protection afforded by Glascote chemical-resistant, acid-alkali glass. Write for Bulletin MG-100 offering complete specifications.

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PRODUCTS, INC.

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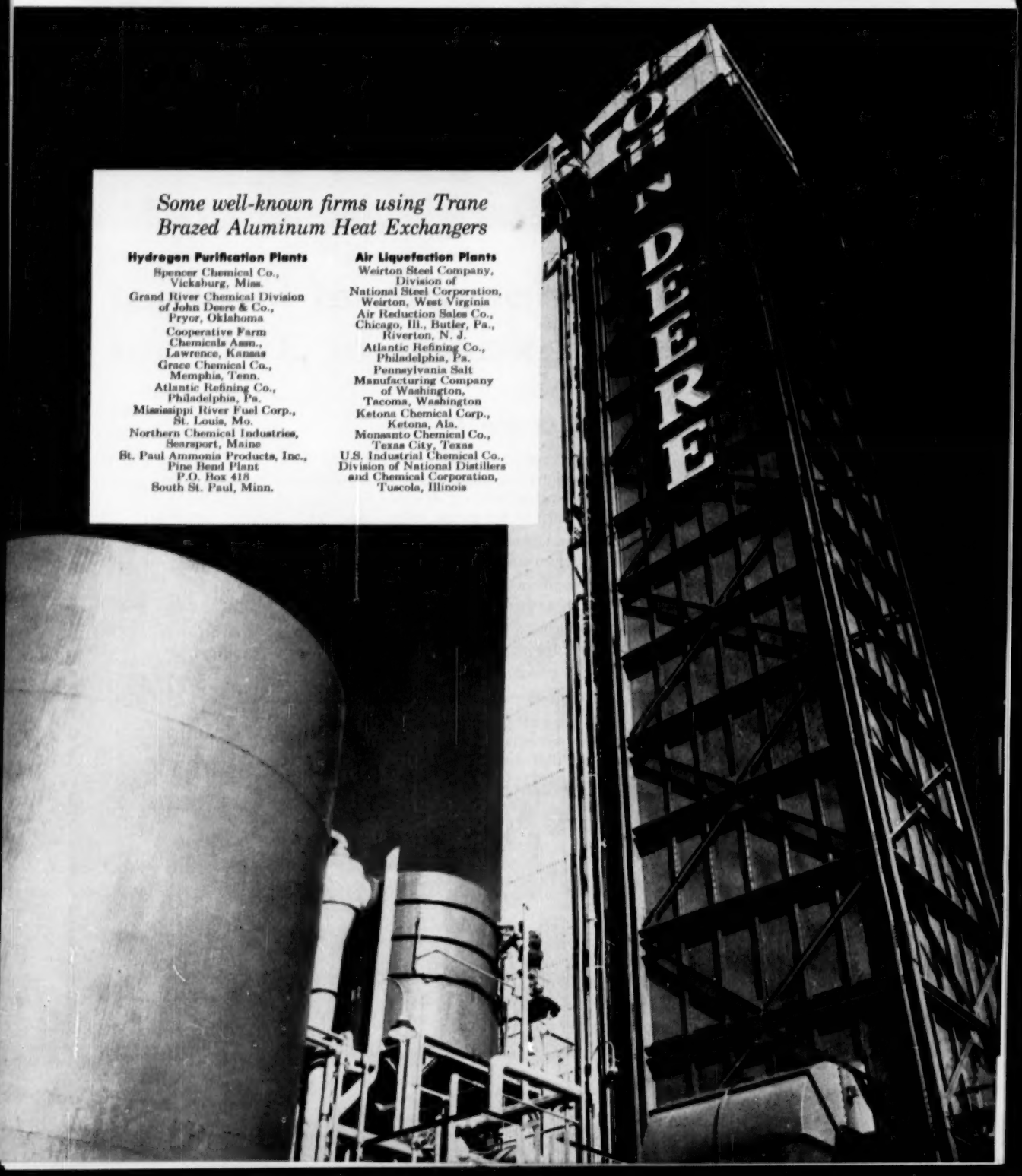
Sales offices or agents in principal cities. Export Sales: A. O. Smith INTERNATIONAL S. A., Milwaukee 1, Wisconsin, U. S. A.

A SUBSIDIARY OF **A. O. Smith** CORPORATION

World's largest manufacturer of glass-protected steel products

After 3 years of service,

5 F temperature approaches with Trane Brazed Aluminum



Some well-known firms using Trane Brazed Aluminum Heat Exchangers

Hydrogen Purification Plants

Spencer Chemical Co.,
Vicksburg, Miss.

Grand River Chemical Division
of John Deere & Co.,
Pryor, Oklahoma

Cooperative Farm
Chemicals Assn.,
Lawrence, Kansas

Grace Chemical Co.,
Memphis, Tenn.

Atlantic Refining Co.,
Philadelphia, Pa.

Mississippi River Fuel Corp.,
St. Louis, Mo.

Northern Chemical Industries,
Searsport, Maine

St. Paul Ammonia Products, Inc.,
Pine Bend Plant
P.O. Box 418
South St. Paul, Minn.

Air Liquefaction Plants

Weirton Steel Company,
Division of
National Steel Corporation,
Weirton, West Virginia

Air Reduction Sales Co.,
Chicago, Ill., Butler, Pa.,
Riverton, N. J.

Atlantic Refining Co.,
Philadelphia, Pa.

Pennsylvania Salt
Manufacturing Company
of Washington,
Tacoma, Washington

Ketona Chemical Corp.,
Ketona, Ala.

Monsanto Chemical Co.,
Texas City, Texas

U.S. Industrial Chemical Co.,
Division of National Distillers
and Chemical Corporation,
Tuscola, Illinois

Foster Wheeler reports . . .

. . .pressures to 300 psig Heat Exchangers!

Trane equipment, operating at −300 F, helps produce ammonia synthesis gas at John Deere nitrogren plant

When Foster Wheeler Corporation designed this synthetic nitrogen plant for John Deere & Company, TRANE Brazed Aluminum Heat Exchangers were used in the nitrogen wash scrubbing system. Now, after more than three years of service, Foster Wheeler reports that the TRANE equipment has operated without trouble of any kind.

In this Foster Wheeler process, the synthesis gas undergoes final stages of purification at temperatures down to -300 F, with operating pressures up to 300 psig.

The performance characteristics of the TRANE Brazed Aluminum surface make it possible to maintain a temperature approach of 5 F at the cold end, thus reducing refrigeration costs while maintaining outstanding purity of the product.

More and more of today's most modern low temperature gas separation plants rely on efficient, lightweight TRANE Brazed Aluminum Heat Exchangers for cutting costs, maintaining high production standards. If you have a heat transfer problem involving low temperatures, multi-stream operation or close approaches, turn to TRANE. Thirty years of varied heat transfer experience is at your service! Ask your TRANE Sales Office for information, or write TRANE, La Crosse, Wisconsin.

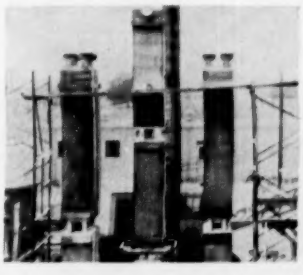
For any air condition, turn to

TRANE

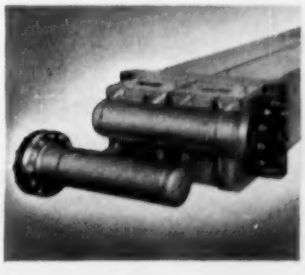
MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

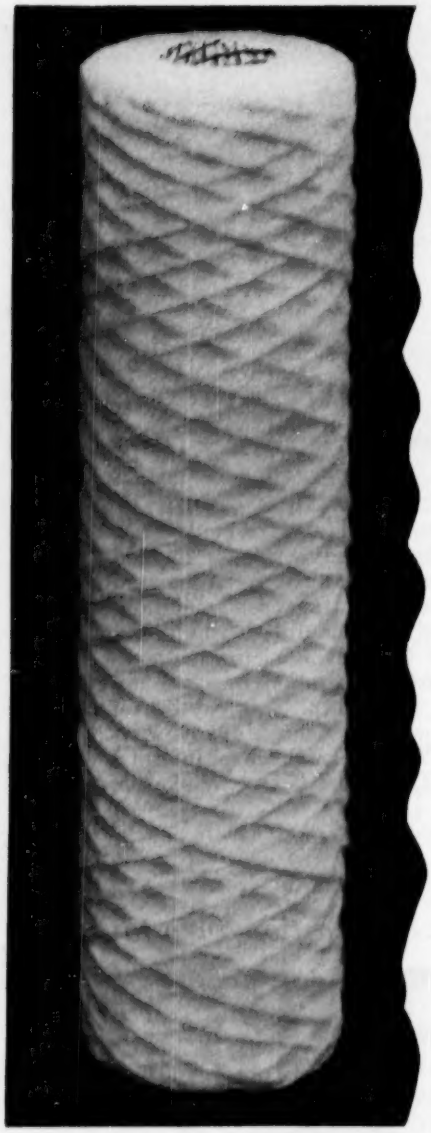
THE GRAND RIVER CHEMICAL DIVISION of John Deere & Company operates one of the country's most modern and efficient synthetic nitrogen plants at Pryor, Oklahoma. Designed and constructed by Foster Wheeler Corporation, this plant produces ammonia from natural gas—most of which is converted to prilled agricultural and feed grade urea. A combination of three processes is used: Synthesis gas generation—including Texaco partial oxidation; Ammonia synthesis—by Casale; Urea synthesis—by Pechiney.

GRACE CHEMICAL COMPANY'S Memphis ammonia plant uses a process similar to that described above, with identical exchangers. Also designed by Foster Wheeler, this system has two lines of switch exchangers and a reboiler that consists of TRANE Brazed Aluminum cores of corrugated fin design. Operation is at approximately 275 psig. Temperatures range from 50 F to -300 F with a 5 F difference between streams entering and leaving the cold end. (Picture taken during installation.)



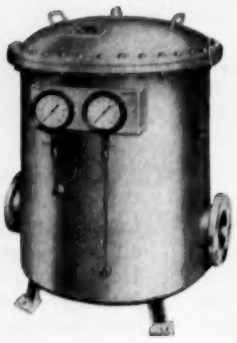
TRANE Brazed Aluminum Heat Exchangers, either individual cores or multi-core assemblies (illustrated at right), may be headered for multi-stream operation combining as many as four different heat exchangers in one unit. The inherent properties of aluminum and the unique design make these exchangers ideally suitable for low temperature applications in gas separation plants. TRANE Brazed Aluminum Heat Exchangers are lightweight, compact—save space, reduce construction costs.





The INSIDE story of *Fulflo Filters*

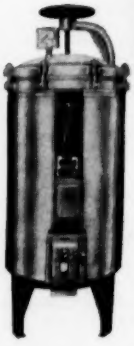
For Continuous Micronic Clarity



Inside every Fulflo Filter is the exclusive Honeycomb Filter Tube . . . engineered in a wide range of positively controlled densities to give you the exact degree of micronic clarity you want. Hundreds of filtering tunnels provide true depth filtration at minimum pressure drop. Honeycomb Filter Tubes are made from cotton, nylon, orlon, dacron, dynel, acetate or glass fibres. Containers are manufactured from iron, steel, stainless steel, rubber-lined steel, or nickel-plated brass.

Fulflo Filters clarify all types of industrial and commercial fluids: liquid chemicals; petro-chemicals; pharmaceuticals; water; compressed air; CO_2 and other gases; liquid fuels; oils. Special models can be engineered for almost any operating condition — high or low viscosity, pH, temperature — even for flow rates as high as 2000 gpm, or pressures up to 5000 psi.

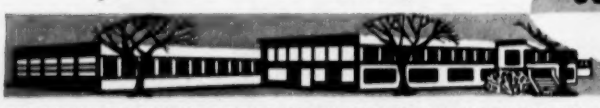
For engineering assistance or technical literature, write Department CE.



OIL FILTERS HAVE WIDE APPLICATION

CFC Filters (including Honan-Crane models) provide selective filtration of virtually any oil under all operating conditions. Multi-Cartridge Filter (illustrated) gives you a choice of six types of interchangeable cartridges — inert media for solid contaminants, or Cranite (fuller's earth) for removal of both solid and dissolved impurities.

Micro-Fine Filtration for Low Cost Clarity



COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

Plants in Melrose, Massachusetts and Lebanon, Indiana

FULFLO FILTERS WITH GENUINE HONEYCOMB FILTER TUBES FOR CONTROLLED MICRONIC CLARITY • CFC MULTI-CARTRIDGE OIL FILTERS
PURIVAC INSULATING OIL CONDITIONERS • DRI-PURE WATER-OIL SEPARATORS • PRE-COAT FILTERS • MAGNETIC SEPARATORS
AUTOMATIC TUBULAR CONVEYORS • COOLANT CLARIFIERS

2880

...he number

...combinations you...

...but when you select...

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MANUFACTURING CO

...1209, Ph. OXford 4-5561.
...er Plaza, New York.
...in all industrial areas . . .
...y oil country.

Because the mortar

Harbison-Walker more than 25 different

Refractory brick structures last longer when the bonding mortar matches the characteristics of the brick. The mortar should correspond with the brick in refractoriness, thermal expansion and other properties and should be compatible in chemical composition. To fulfill the requirements for the many different types and classes of refractory brick and operating conditions, Harbison-Walker produces more than twenty-five bonding mortars.

Included in this wide range are some mortars which set with a strong bond upon drying, which is retained at high temperatures, and others which acquire a good ceramic set only when heated. The

Some of the Various Types and Classes

BRAND	DESCRIPTION	TYPICAL APPLICATIONS
HARWACO BOND wet or dry	Cold-Setting with strong bond and negligible shrinkage—alumina-silica composition—more refractory than any mortar of fireclay base.	Used for laying all classes of fireclay and high alumina brick in boiler settings—kilns—oil refining units—metallurgical furnaces.
HARWACO MASTIC wet or dry	Corresponds to HARWACO BOND in composition—especially adapted for use in thick plastic consistency.	For pointing or sealing cracks in brickwork—as a protective coating—monolithic packing back of water-wall tubes—air duct linings.
CORALITE BONDING MORTAR wet	High alumina cold-setting cement of unusually high refractoriness.	For laying all classes of alumina-silica brick used at unusually high temperatures in contact with molten metals and various corrosive slags.
KORUNDAL BONDING MORTAR dry	Cold-setting bonding mortar containing approximately 85% alumina. Mineral composition mullite and corundum. Extremely high in refractoriness.	Used for laying all classes of high-alumina brick. Very resistant to corrosion by volatile alkalies and slags of certain metallurgical furnaces.
H-W CORUNDUM BONDING MORTAR dry	Substantially an all corundum cold-setting mortar of 99% alumina content.	The ultimate in refractoriness among high alumina mortars—used with greatest benefit at highest temperatures.
THERMOLITH dry	Chrome base cold-setting mortar. Highly resistant to many very corrosive fluxes.	Most extensively used for laying magnesite, chrome and forsterite brick. Also favored for use with fireclay and high alumina brick in many special applications.

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES

World's Most Complete Refractories Service

General Offices: PITTSBURGH 22, PA.

is as important as the brick . . .

Walker provides BONDING MORTARS

mortars with hot-setting properties contribute to flexibility in expansion and contraction of structures which are subjected to soaking heats throughout. Chemical compositions vary from highly basic, through various degrees of neutral to strongly acid, and in each specific case provide for maximum resistance of the joints to the widely different corrosive slags and fumes. Among these compositions are those consisting largely of magnesia, forsterite (magnesium silicate) chrome, corundum (stabilized crystalline alumina), silica and alumina-silica in various ratios.

Adequate refractoriness to secure the most durable and impervious joints and smooth-working plasticity with proper water retention are other properties of major importance for these mortars.

In addition to the different kinds described in the following table, Harbison-Walker produces others, including hot-setting mortars such as H-W FURNACE MAGNESITE, H-W SPECIAL FURNACE CHROME, H-W BONDING MORTAR and various brands of finely ground high duty and super-duty fireclays as well as several modifications of silica cements and mortars primarily for laying insulating fire brick.

From these bonding mortars can be selected those best suited for each specific application to secure longest furnace life and greatest economy.

of Harbison-Walker Bonding Mortars

BRAND	DESCRIPTION	TYPICAL APPLICATIONS
H-W FORSTERITE BONDING MORTAR dry	Strong cold-setting, magnesium silicate mortar of basic character.	For use at high temperatures with H-W FORSTERITE brick in glass-melting and various metallurgical furnaces.
H-W PERIKLASE BONDING MORTAR dry	Basic, highly refractory, cold-setting mortar used for laying H-W PERIKLASE and other basic brick.	Used in electric and open hearth steel melting furnaces, glass furnaces, rotary kilns.
FIREBOND dry	Siliceous cold-setting bonding mortar having the property of high resistance to siliceous slags.	Used for laying silica brick where strong bonded joints are desirable and with fireclay brick for dense impervious joints at moderate temperatures.
VEGA BOND dry	Hot-setting silica cement of super-duty quality. Non-shrinking and smooth working.	For laying and grouting conventional and super-duty silica brick in all their applications.
ANKORITE dry	High alumina hot-setting mortar possessing excellent working qualities. Provides flexibility to brickwork in soaking heats over an intermediate temperature range and a strong set at the furnace operating temperatures.	Used for laying super-duty and high duty fireclay brick and the various classes of high alumina brick where a highly refractory heat setting mortar serves to best advantage.
H-W WEATHERED BOND B CLAY dry	Hot-setting bonding mortar. Excellent plasticity and bonding qualities developed by a long weathering process.	Used with splendid results for laying fireclay brick in boiler settings, iron blast furnaces and stoves.

Use this coupon to get prices and additional information about Harbison-Walker Bonding Mortars

Harbison-Walker Refractories Co.
Pittsburgh 22, Pa.

Please send me prices and information about the following bonding mortar(s)

_____

_____

NAME_____ POSITION_____

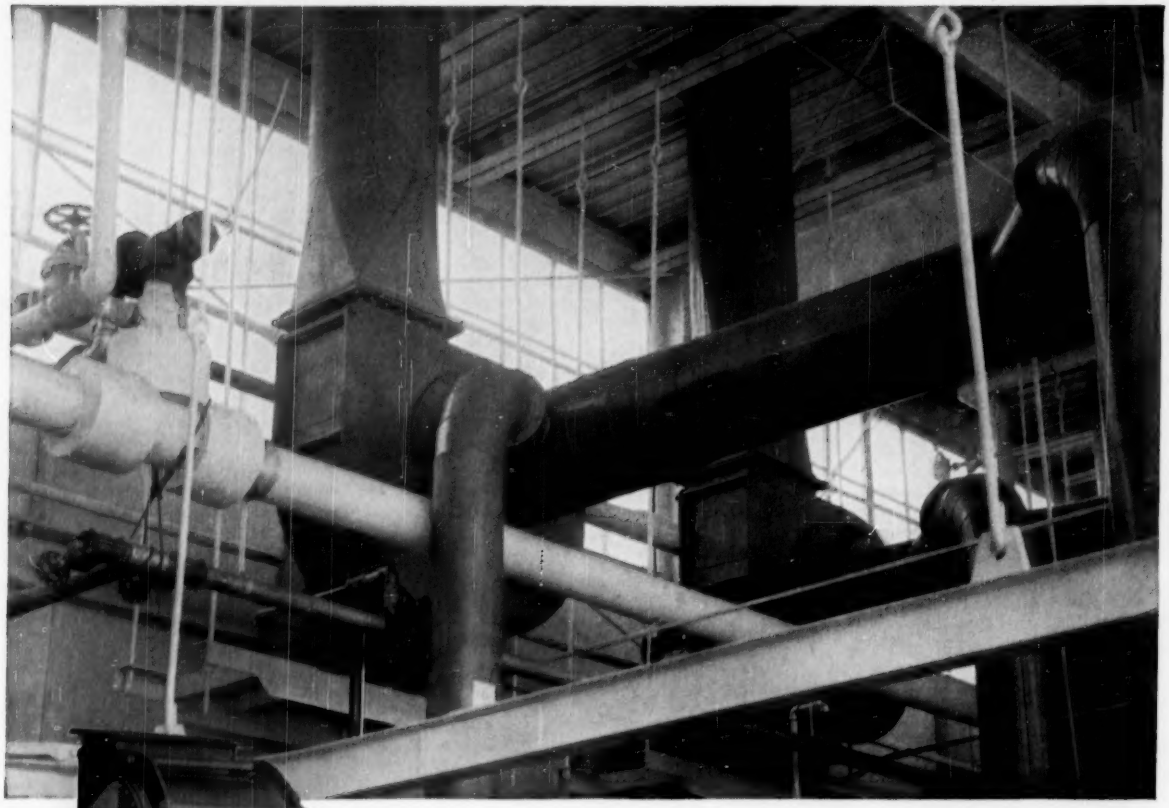
COMPANY_____

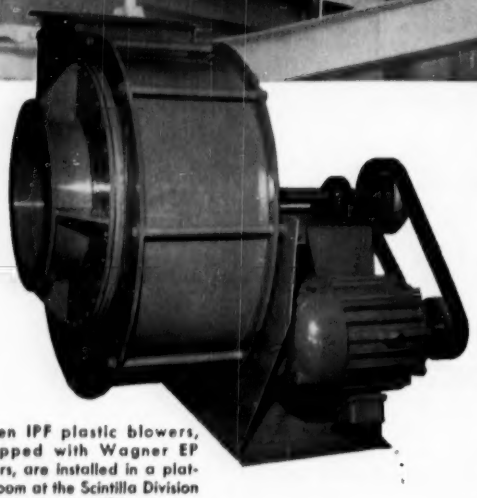
ADDRESS_____

WAGNER ELECTRIC MOTORS...THE CHOICE OF LEADERS IN INDUSTRY

WAGNER EP MOTORS

team up with newly developed blowers





Eleven IPF plastic blowers, equipped with Wagner EP Motors, are installed in a plating room at the Scintilla Division of Bendix Aviation Corporation, Sidney, New York. Type EP Motors are available in ratings from 1 to 250 hp.

Provide the answer to trouble-free expulsion of corrosive fumes in plating process

Expelling corrosive fumes and gases has been a tough problem for industry. Now, a new all plastic blower, developed by Industrial Plastic Fabricators, Inc., withstands most chemical fumes and gases from 40°F to 140°F at blower inlet.

But such blowers should have corrosion-resistant motors to drive them. That's why Wagner Type EP Motors were chosen in the IPF blower installation shown above. These motors are fully protected against corrosive fumes and liquids, dust, dirt and moisture. Such protection is assured by totally enclosed, fan-cooled construction in corrosion-resistant cast iron frames.

Full information and principal dimensions of these motors are given in Wagner Bulletin MU-203. Write for your file copy. Your nearby Wagner engineer can help you select the right motor for your applications. Call the nearest of our 32 branch offices, or write us.

WM57-2

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SERVING INDUSTRY SINCE 1891

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Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

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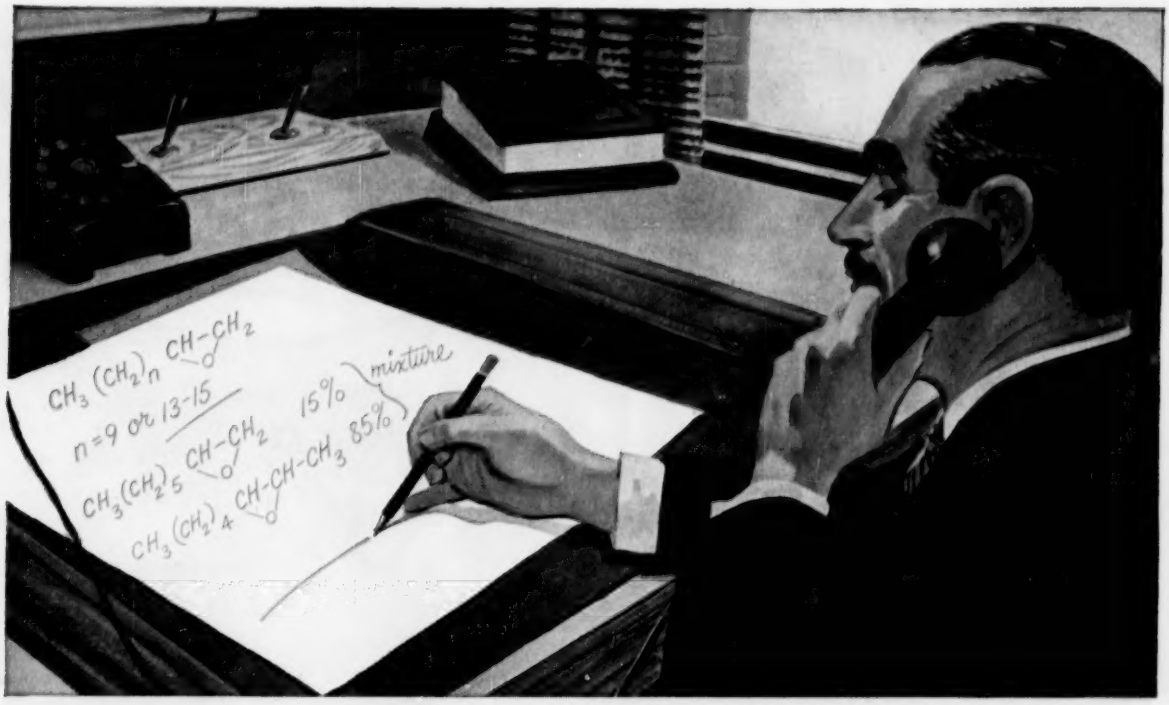

Where can you use Olefin Epoxides, now available in development quantities?

Perhaps we can offer a few suggestions. New Olefin Epoxides now available in development quantities from Becco are showing great promise in applications, such as:

1. general solvents
2. solvents and reactive diluents for epoxy resins
3. intermediates in manufacture of: perfumeries, cosmetics, surfactants, plastics, lubricants
4. acid scavengers
5. corrosion inhibitors
6. stabilizers for chlorinated compounds
7. monomers
8. organic synthesis intermediates

These epoxidized Olefins, developed by Becco as a result of extensive research in epoxidation reactions, combine variable length hydrocarbon structures with reactive epoxy groups and undergo reactions such as polymerization, isomerization, reduction and ring-opening with a variety of active hydrogen compounds.

The compounds offered are high assay epoxides:

	F.P.°C	B.P.°C	Density at 25°C	Solubility
OCTYLENE OXIDE mixed 1,2-and 2,3-epoxy-n-octanes	< −50	76-78 (45mm)	0.830	very slightly soluble in water, soluble in hydrocarbons and other organic solvents.
DODECENE OXIDE 1,2-epoxy-n-dodecane	ca −10	97-98 (3.5mm)	0.836	insoluble in water, soluble in hydrocarbons and other organic solvents.
C_{14}—C_{18} OLEFIN OXIDE mixed 1,2-epoxy-n-hexadecane and -n-octadecane	ca 15	>110 (0.5mm)	0.842	insoluble in water, soluble in hydrocarbons and other organic solvents.

If you are interested in possible applications of these epoxy compounds, we shall be glad to supply experimental quantities and technical assistance. Why not begin by writing for your free copies of Bulletins 72, 73, and 74 — there is no obligation.

BECCO CHEMICAL DIVISION
Food Machinery and Chemical Corporation
Station B, Buffalo 7, New York

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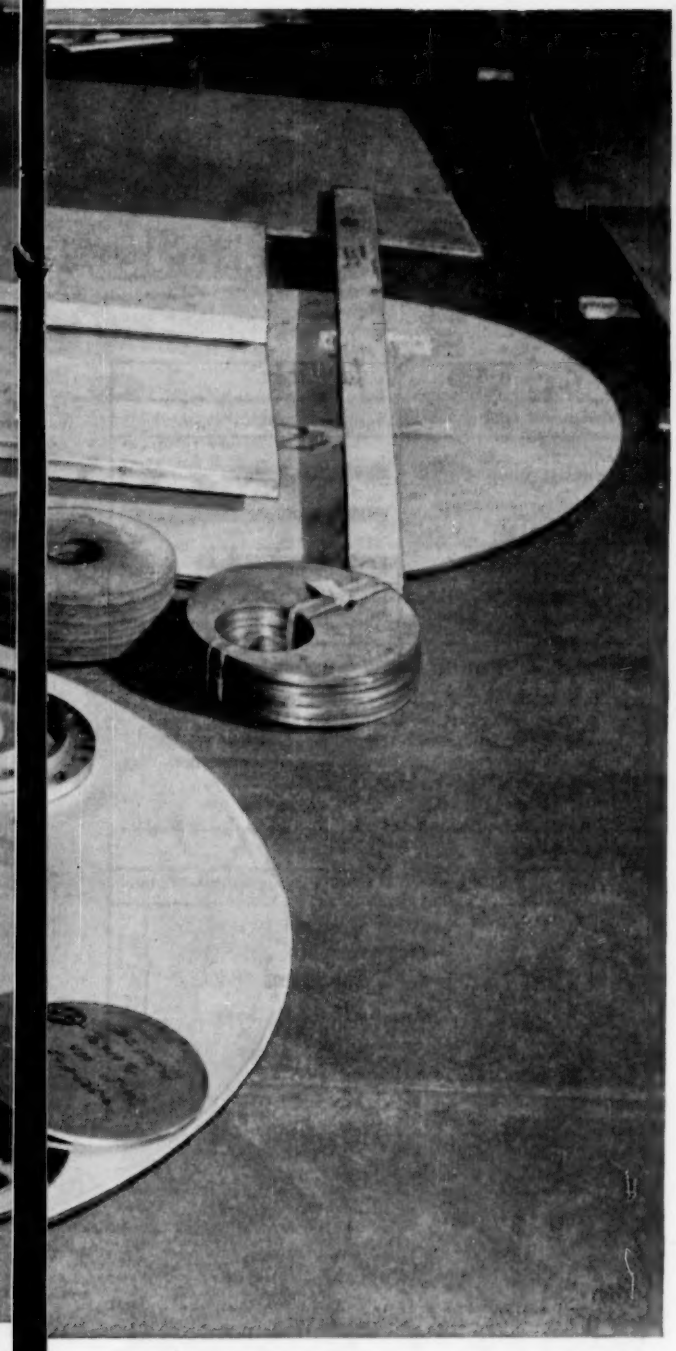
FMC CHEMICALS INCLUDE: BECCO Peroxygen Chemicals • WESTVACO Phosphates, Barium and Magnesium Chemicals • WESTVACO Alkalis, Chlorinated Chemicals and Carbon Bisulfide • NIAGARA Insecticides, Fungicides and Industrial Sulphur • OHIO-APEX Plasticizers and Chemicals • FAIRFIELD Pesticide Compounds and Organic Chemicals

12"x 2" Disc or 200"x 132"x 2" Plate

...Carlson is your ONE source for ALL stainless steel components

STAINLESS STEEL PLATES • PLATE PRODUCTS • HEADS • RINGS



Check your drawings and you may find that you require all of the stainless steel items shown here—plates, heads, tube sheets, discs, forgings, flanges, rings, special patterns, bars, and sheets (#1 Finish) in the heavier gauges. When you buy all these material components from one source you save time, effort and money.

Your assembly costs are kept to a minimum when you use Carlson's abrasive cut material. Cleaner edges mean less true-up time on the job. There is no heat-affected zone because little heat is developed during the cutting. Fabrication is easier and the finished product is of the highest quality, more dependable in use.

Who pays freight on "offcuts" you can't use? No one, when you use Carlson's service for cutting plate to shape, ready for your fabrication. Plate is sheared, sawed, flame or abrasive cut and machined to your specifications. Eliminating freight charges on excess material lowers your costs.

There's the matter of delivery which also means time and money to you. As specialists in stainless steels, Carlson has the diversified equipment and the technical and practical knowledge to produce the plate or shapes you want, the way you want them with delivery as promised.

Stainless Steels Exclusively

G. O. CARLSON Inc.

THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

DISCS • FORGINGS • FLANGES • BARS AND SHEETS (No. 1 Finish)

Kaiser Aluminum sheet for jacketing offers new economies through improved application methods

Recent developments make possible new low costs for the power, refinery and chemical industries

As YOU can see in the relative cost charts at the right, aluminum sheet jacketing now offers the *lowest first cost* of four well-known finishing methods for pipe insulation . . . and it offers *lower first cost* than wet-construction finishing methods for vessel insulation.

Another important fact, not revealed in the charts, is that aluminum's first cost is becoming *increasingly* competitive, thanks to newly-developed methods that speed application and reduce labor costs!

And if maintenance costs were added to the comparisons, aluminum would present an *even better value*—because only aluminum eliminates maintenance.* Its remarkable resistance to corrosion eliminates the need for painting . . . even when exposed to weather and mechanical abuse.

New Dry Wall Construction for Vessels

A number of improvements in application technique—developed by Kaiser Aluminum engineers in cooperation with specialists from various industries—adapt dry-wall type construction to the finishing of large cylindrical and flat insulated surfaces. These techniques virtually eliminate the need for costly application methods used to apply wet materials such as insulating cements, emulsions, mastics, adhesives, glue sizing and paint. Where corrugated aluminum sheets are used, positioning and fastening are simplified and speeded by familiar techniques employed for block insulations.

New "Snap-Back" Aluminum Jacketing Speeds Installation on Piping

Aluminum's unique advantages in light weight and superior workability have made possible greatly simplified preformed "snap" jackets for quick, easy application on piping.

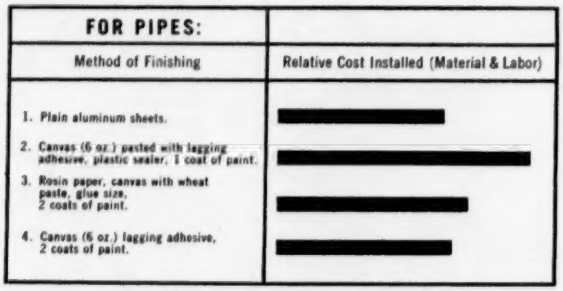
Jacketing, preformed into undersize tubes from stiff sheets of aluminum, will snap back to a tight fit when placed over pipe insulation, freeing both hands for fastening. This tight fit requires less fasteners per running foot.

The following is an outline discussion of important factors in aluminum jacketing materials and alloys, with suggested application methods best suited to various insulated surfaces, including pipes, vessels, vessel heads and others.

The Jacketing Alloys

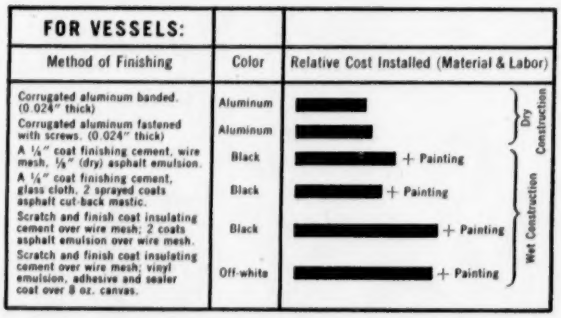
The following aluminum alloys, supplied in flat or coiled sheets, are successfully used for insulation jacketing: 1100, 3003, 3004, 5005, 5050, 5052, Kaiser Aluminum industrial roofing and siding alloy, and Kaiser Aluminum standard roofing alloy.

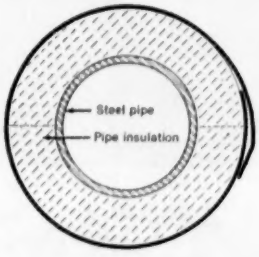
*Roofing felt has a lower initial cost than aluminum, but painting and maintenance offset this initial cost advantage.


FOR PIPES:
Method of Finishing
Relative Cost Installed (Material & Labor)
1. Plain aluminum sheets.
2. Canvas (6 oz.) pasted with lagging adhesive, plastic sealer, 1 coat of paint.
3. Rosin paper, canvas with wheat paste, glue size, 2 coats of paint.
4. Canvas (6 oz.) lagging adhesive, 2 coats of paint.

Results of first cost analyses of various insulation finishes

NOTE: Charts show first costs only. To arrive at total costs, maintenance costs must be added. Whereas other finishing methods require frequent and costly maintenance, aluminum jacketing is virtually maintenance-free.


FOR VESSELS:
Method of Finishing
Color
Relative Cost Installed (Material & Labor)
Corrugated aluminum banded. (0.024" thick)
Aluminum
Corrugated aluminum fastened with screws. (0.024" thick)
Aluminum
Dry Construction
A ¼" coat finishing cement, wire mesh, 1/8" (dry) asphalt emulsion.
Black
+ Painting
A ¼" coat finishing cement, glass cloth, 2 sprayed coats asphalt cut-back mastic.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; 2 coats asphalt emulsion over wire mesh.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; vinyl emulsion, adhesive and sealer coat over 8 oz. canvas.
Off-white
+ Painting
Wet Construction



Sketch shows how preformed jacketing snaps back over piping, providing quick installation combined with tight fit. This is also demonstrated in photo titled "Teamwork."

Based on maximum economy and performance, the general recommendation is the use of Kaiser Aluminum alloy 5005 and Kaiser Aluminum industrial roofing and siding.

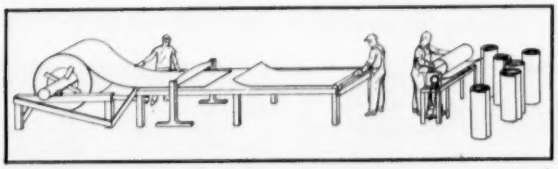
The reasons for this recommendation, and the exceptions to it, are as follows:

(a) Alloys in the 5000 series (which contain magnesium as the principal alloying element) and the clad alloys, such as AlClad 3004 (from which Kaiser Aluminum industrial roofing and siding sheet is made), offer superior corrosion resistance—especially in marine atmospheres.

(b) Alloy 5005 and the industrial roofing and siding alloy provide top performance at lowest cost for most jobs. Alloy 5050 shows an advantage from the standpoint of strength over 5005, and in many instances its slightly increased cost (a fraction of a cent per square foot) is warranted. Where exceptional strength is required, alloy 5052 should be used.

(c) Closely allied with alloy selection is a consideration of the section modulus of jacketing for large diameter vertical vessels. Kaiser Aluminum industrial roofing and siding sheet is superior in section modulus. On certain vertical vessels, usually those in the range of 3′ to 12′ in diameter, some designers prefer the close-up appearance of smaller corrugations. When this is preferred, most of the common alloys and the standard corrugated roofing alloy are satisfactory. Sheets should be 0.024″ thick, embossed, corrugated to 1¼″ x ¼″, and supplied in finished widths of 26″.

A metal thickness of 0.024″ is recommended in most cases. Corrugated aluminum 0.024″ thick can be banded at less material and labor cost than the thinner 0.019″ material fastened with screws. For insulated pipes with an O.D. of 12.75″ and less, 0.020″ thick aluminum sheet is recommended.



These illustrations show method used to fabricate snap jackets:

1. Using aluminum of proper alloy and temper . . .
2. Cutting it to proper dimensions for easy, economical installation . . .
3. Properly stiffening the overlapping edge by a simple angular crimp . . .
4. Forming it through a roller for proper circumference . . .
5. Snapping it around insulated pipe (below).

Teamwork—with one man to snap jackets in place and another to band them, two men can cover 700 feet of 10-inch diameter tubing in one day!

The best temper for pipe jacketing is ¾ hard, designed as H-16 or H-36. For fitting jackets requiring numerous lock seams, ½ hard temper, H-14 or H-34, is recommended.

Pipe Jackets

Snap jackets are a quick, easy and economical method of enclosing insulated pipe. The simple process shown above produces a most effective jacket for pipe insulation. (Kaiser Aluminum's booklet, *"Insulation Jacketing Materials and Methods,"* explains and describes the process in full detail.)

The alloy recommended is 5005-H16, in coiled sheet form with plain finish. Embossed finishes are also available. Other alloys may be used, but it is desirable to use one alloy throughout. Width of coiled sheet should be 36″. Recommended thicknesses of sheets are 0.020″ for insulation O.D. of 12.75″ and under, and 0.024″ for insulation O.D. of 14″ and larger.

Vessel Jackets

Insulated vessels 36″ O.D. and less—horizontal or vertical—should be jacketed with 0.024″ thick by 36″ wide 5005-H16 alloy sheet, plain finish preferred.

For insulated vessels larger than 36″ O.D., horizontal mounting, use the same coiled sheet as above; for vertical mounting, use Kaiser Aluminum industrial roofing and siding, 0.024″ thick, embossed finished, ⅞″ deep corrugations with 2.67″ pitch.

Jackets for Large, Flat Surfaces

For breechings and ducts, indoors and out, Kaiser Aluminum industrial roofing and siding, 0.024″ and 0.032″ thick and having ⅞″ deep by 2.67″ pitch corrugations are most economical. Flat sheet, fluted sheet, and flat sheets stiffened with roll-formed standing seams offer other possibilities.

For insulated boiler walls, jackets may be made of aluminum sheets of several types. Thickness, size and fastening method will vary with specific boiler designs.

Fasteners

For pipes and vessels with insulation O.D. 36″ or smaller, bands may be slit from the same aluminum sheet used for pipe jackets, or they may be purchased as standard stock items. For pipe insulation O.D. 12.75″ and smaller, bands should be ½″ wide by 0.020″ thick, equal to A. J. Gerrard #305-AL; seals should be equal to A. J. Gerrard #202-AL. For pipe or vessels with insulation O.D. 14″ to 36″, bands should be ¾″ wide by 0.020″ thick, equal to A. J. Gerrard #311-AL; seals should be equal to A. J. Gerrard #204-AL. For vessels with insulation O.D. 36″ and larger, ¾″ wide by 0.020″ thick #18-8 stainless steel expansion bands should be used. Banding should be equal to A. J. Gerrard Expand-R-Strap, #E311 ½ S-4; seals should be #18-8 stainless steel, equal to A. J. Gerrard #204-SS.

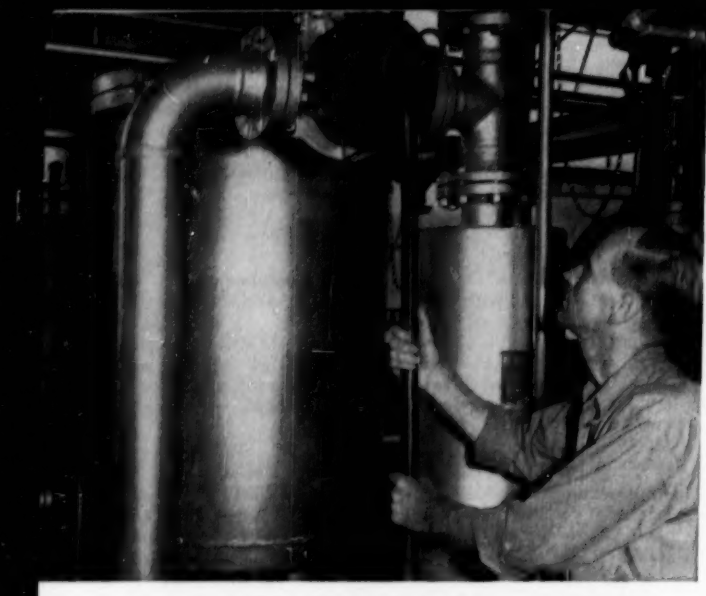
When required for pipe and fitting jackets, #7 by ½″ aluminum pan head self-tapping screws, Type A, are suggested. Side laps and flashing with corrugated vessel jackets should be fastened with #7 x ¾″ aluminum pan head screws, Type A. Aluminum screws should be made from either 6061-T6 alloy or anodized 2024. For fastening aluminum jackets to steel structural members, use #14 hex head screws, Type B, made from stainless steel #18-8 alloy; #410 is acceptable.

Composite studs made from #18-8 stainless steel and aluminum (equal to Nelson Rivweld Studs or to Nelson Set Lock Studs supplied with aluminum washers) may be used to fasten corrugated aluminum jackets to angles. On siding, fasten studs on low part of corrugation. On roofing, fasten studs on crown of corrugation.

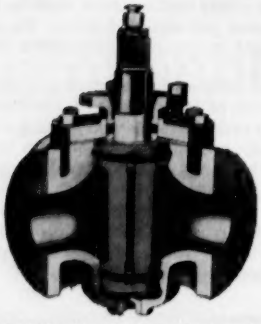
Aluminum Jacketing Booklet Available

Kaiser Aluminum's new booklet, *"Insulation Jacketing Materials and Methods,"* gives you complete details on the subjects outlined above. It also presents illustrated step by step application methods plus material and accessories charts to help you take advantage of recent advances in aluminum sheet jacketing. Forty fully illustrated pages in all! To get your free copy, write to: *Kaiser Aluminum & Chemical Sales, Inc., Process Industries Department, 919 N. Michigan Ave., Chicago 11, Illinois.*

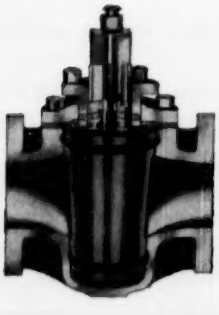
Kaiser Aluminum



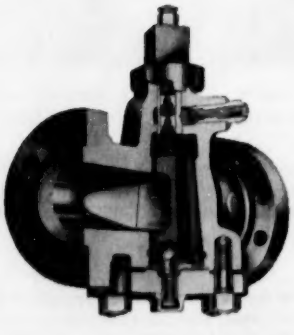
HOW TO



PHARMACEUTICALS



WATER



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STOP COSTLY VALVE FAILURES

The sure way to end valve problems—and get better flow control at lower cost—is to specify lubricated plug valves throughout the plant. Rockwell-Nordstrom valves stop costly valve failures because they are positively sealed by an instantly replaceable soft seat of pressurized lubricant. And since vital seating surfaces are protected from the line, corrosion is minimized. Longer valve life at lower cost is further insured by the lubricant which eliminates metal-to-metal friction wearing.

Rockwell-Nordstrom lubricated plug valves are available in a complete line of sizes and pressure ratings in semi-steel, steel, stainless, Monel, bronze and other corrosion resisting metals. They cost no more to buy—often less—than ordinary valves. Write for complete details: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

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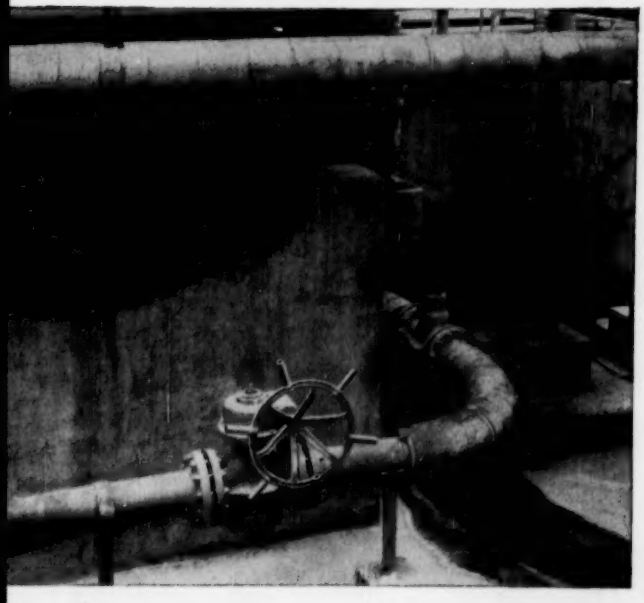

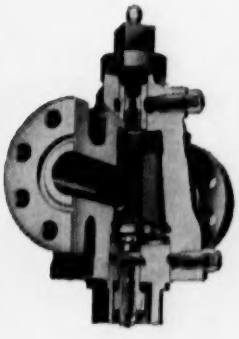

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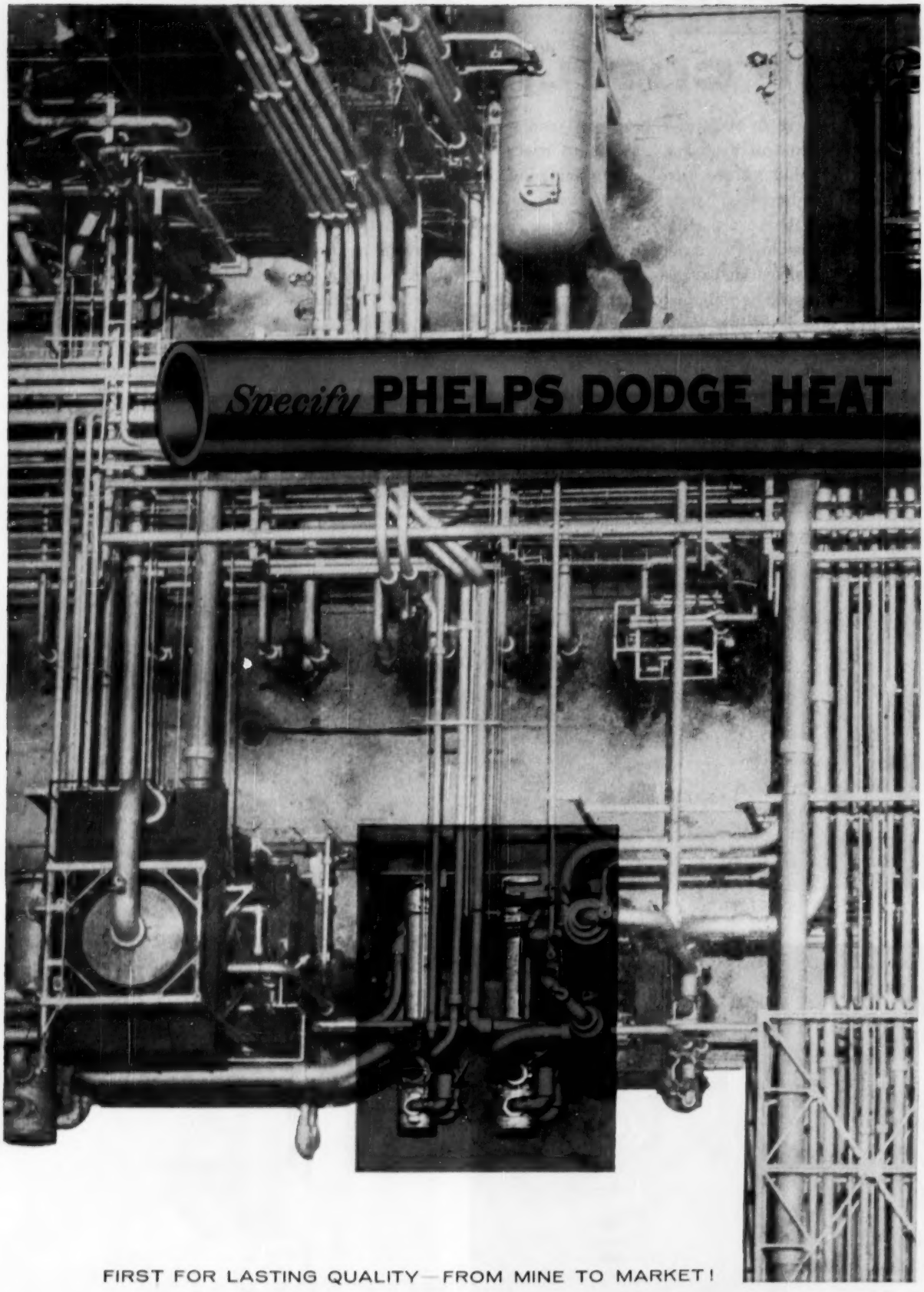

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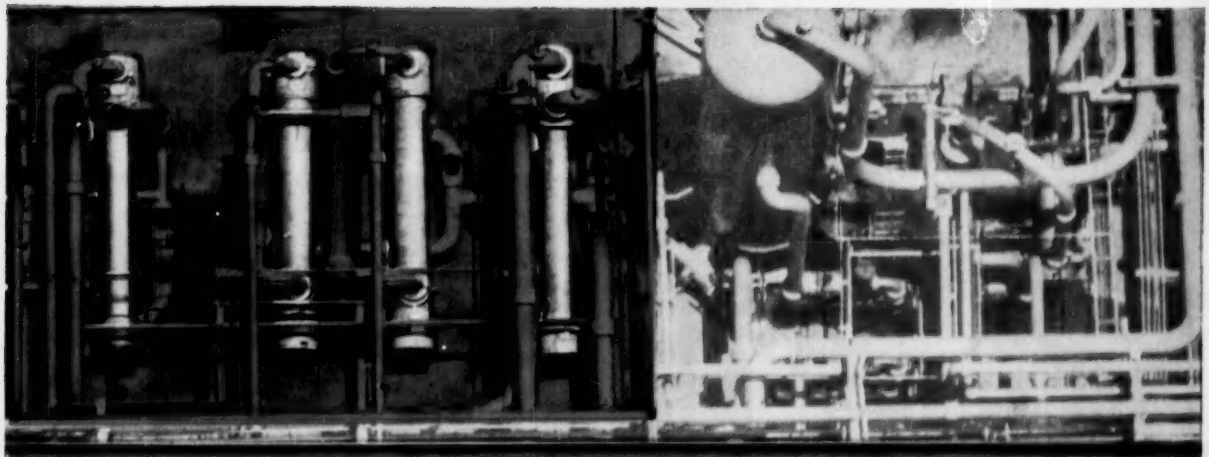

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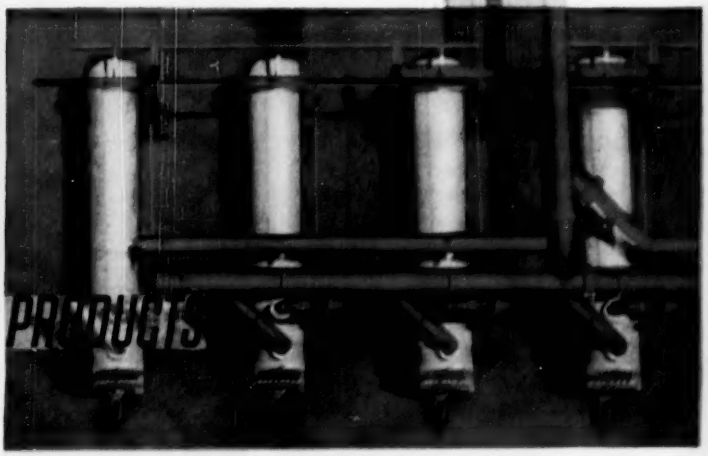
- Complete control of quality throughout every step of manufacture.



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Allis-Chalmers announces... **Newly**

1

Gang-operated disconnect switch isolates starter from incoming power — assures safe entry of high voltage compartments.

2

Steel cubicle is compartmentalized — separates high and low voltage equipment.

3

Short-circuit protection is provided by fast-acting current-limiting fuses, rated 150,000 kva at 2300 volts and 250,000 kva at 4160 or 4600 volts.

4

Overload protection is handled by accurate relays which trip only on excessive motor current, preventing needless motor stoppages.

5

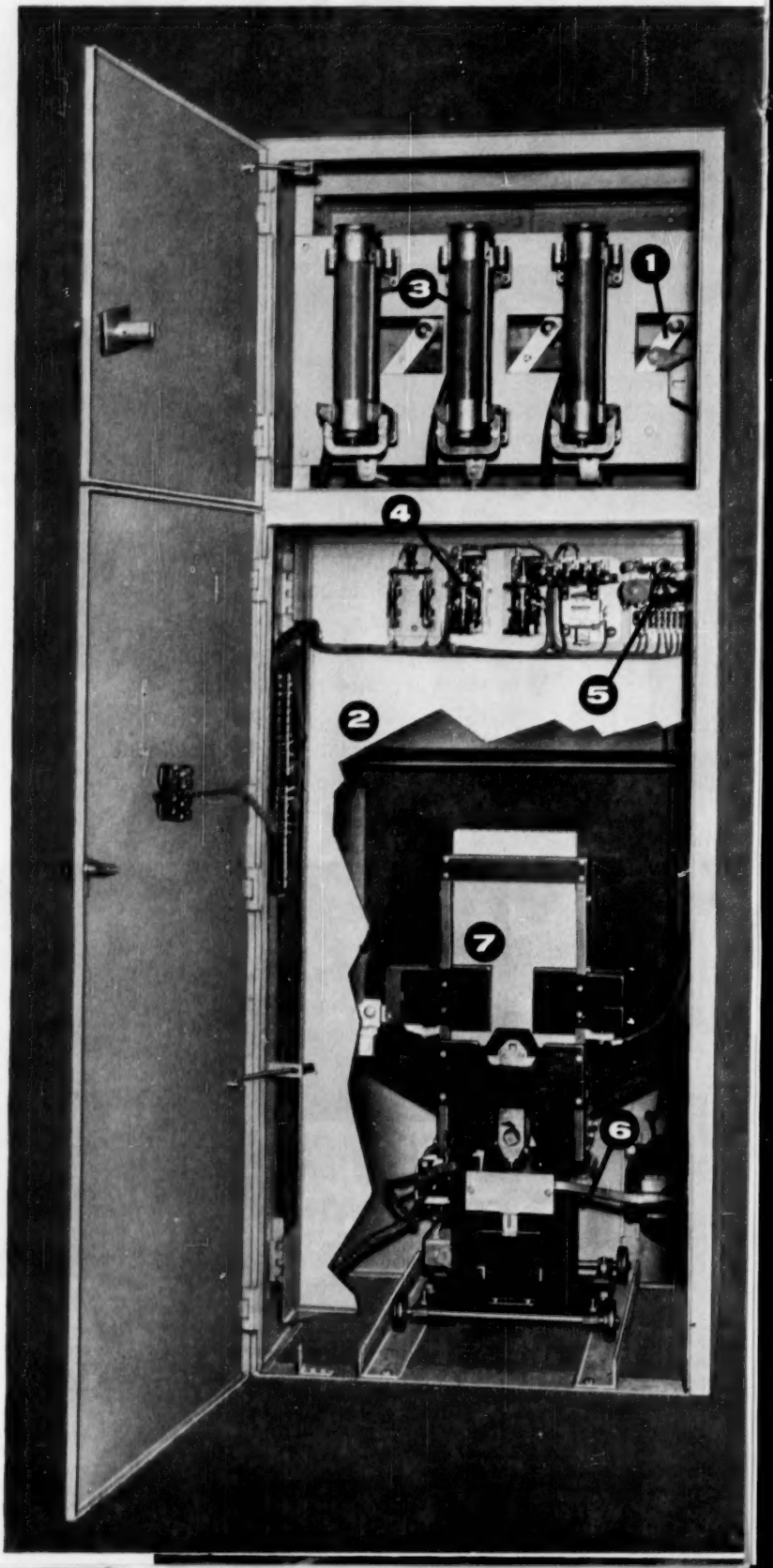
Undervoltage protection instantaneously opens line contactor on loss of voltage. Time-delay undervoltage protection also available.

6

Mechanical interlock coordinates contactor, disconnect switch, upper door and inner control barrier for maximum safety.

7

Roll-out contactor makes maintenance easy—even in narrowest aisle space. (Routine inspection and maintenance can be done with contactor in place.)



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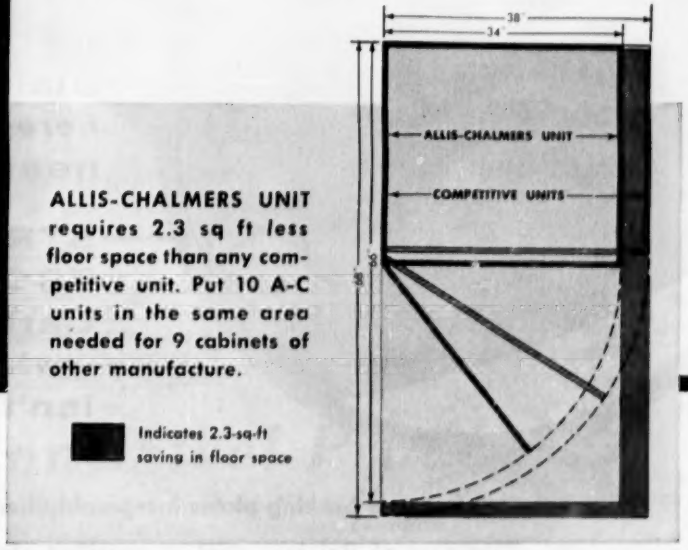
Here is control that couples compactness with roominess (for ease of maintenance) . . . here is a starter that joins test-proven performance with versatility (for addition of meters and relays) — AND the line meets every 2300 to 5000-volt motor need.

For more information on this engineering advance, contact your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



ALLIS-CHALMERS UNIT requires 2.3 sq ft less floor space than any competitive unit. Put 10 A-C units in the same area needed for 9 cabinets of other manufacture.

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PROTECTION of Stainless Steel *here*—where it's needed.

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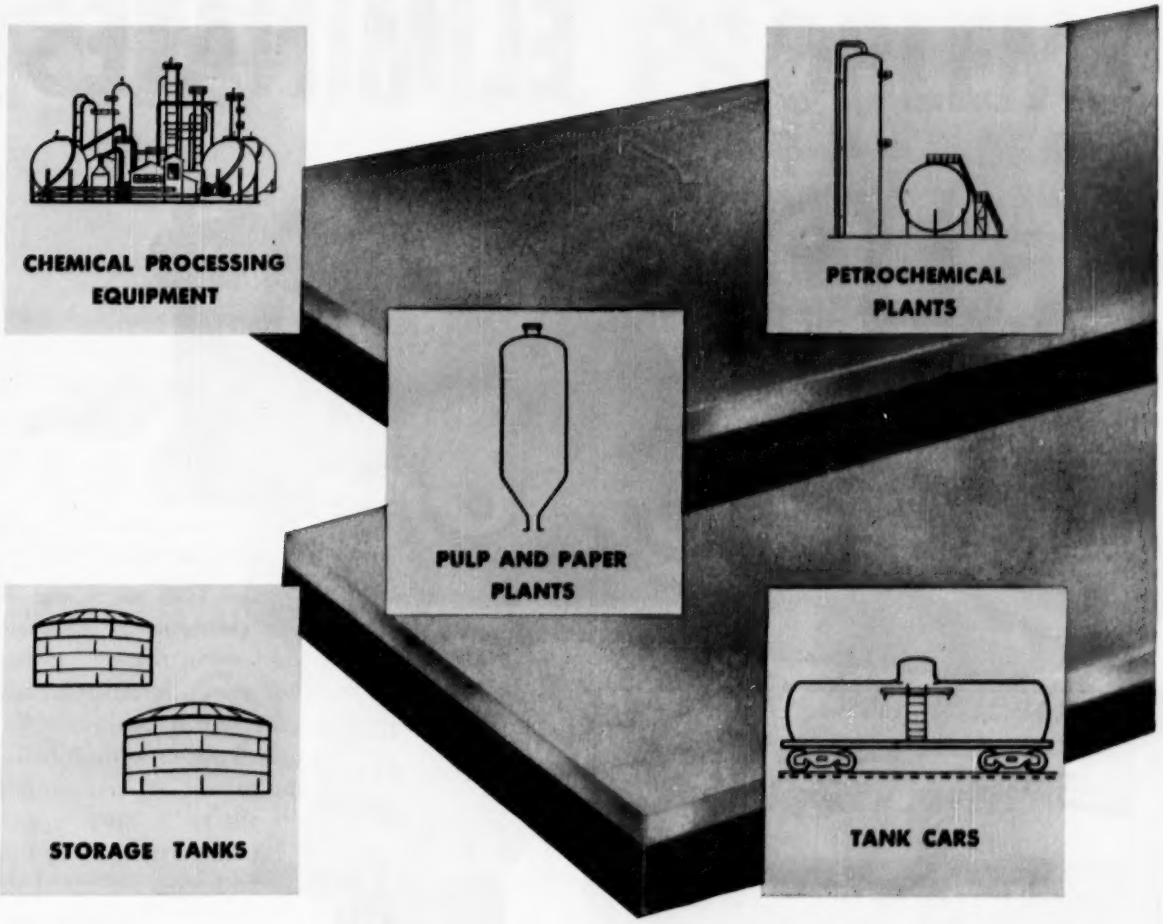
USES FOR STAINLESS-CLAD



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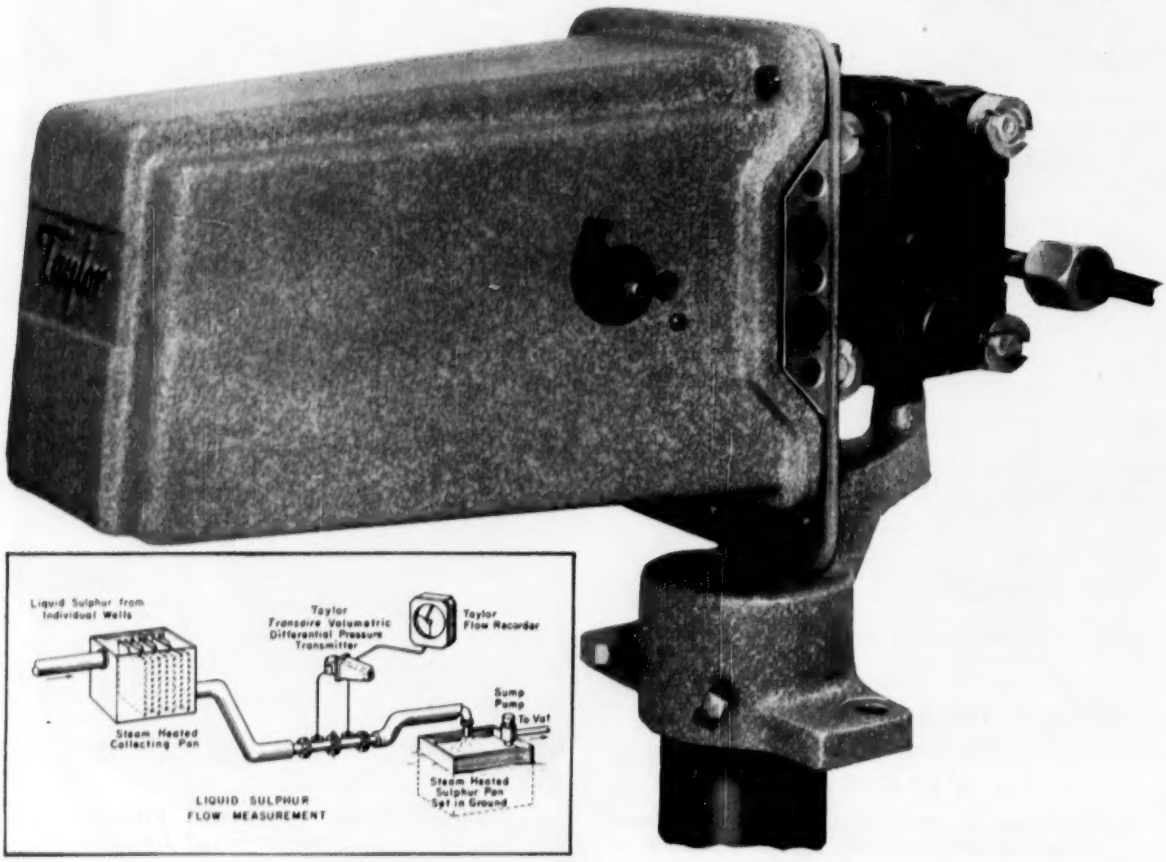
~~SEAL~~ PROBLEMS

~~PURGE~~ PROBLEMS

ELIMINATES



Liquid Sulphur from Individual Wells
Taylor Transoire Volumetric Differential Pressure Transmitter
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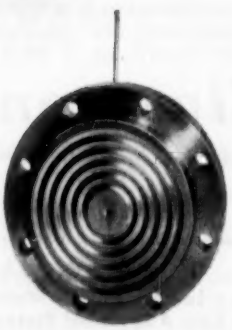
LIQUID SULPHUR FLOW MEASUREMENT

Type 95 flange, for use with chemical tee. For flow installations where diaphragm is flush with inside of pipe, so that process fluid imparts a scouring action. Also for liquid level applications where diaphragm should be flush mounted.



New Taylor Volumetric Differential Pressure Transmitter

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Ideal for these difficult flow and liquid level measurements:

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- Colloidal suspensions
- Fluids that jell when not in motion.

The new Taylor 205T Volumetric Differential Pressure Transmitter is completely isolated from the process material. Thus it never has to be purged of deposited material, never suffers from corrosion. The pressure-sensitive diaphragms may be installed flush with the inside of the pipe or tank in a variety of mountings. The temperature limit is 300° F. at the diaphragms. Pressure limit of the instrument is 1500 lbs., and the system is limited only by the flange rating on the primary side.

This instrument is a modification of the familiar Taylor 333RD differential pressure transmitter, and is just as accurate, sturdy and dependable. For full details about this new instrument, ask your Taylor Field Engineer, or write for **Bulletin 98281.** Taylor Instrument Companies, Rochester, N. Y. and Toronto, Canada.

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Wafer type sensing element, for use with Standard 3" ASA flange, where diaphragm need not be flush mounted with process. For example, corrosive flow or liquid level measurement or colloidal suspensions. Standard diaphragm material, for both types, 316 Stainless steel, Hastalloy B, nickel.

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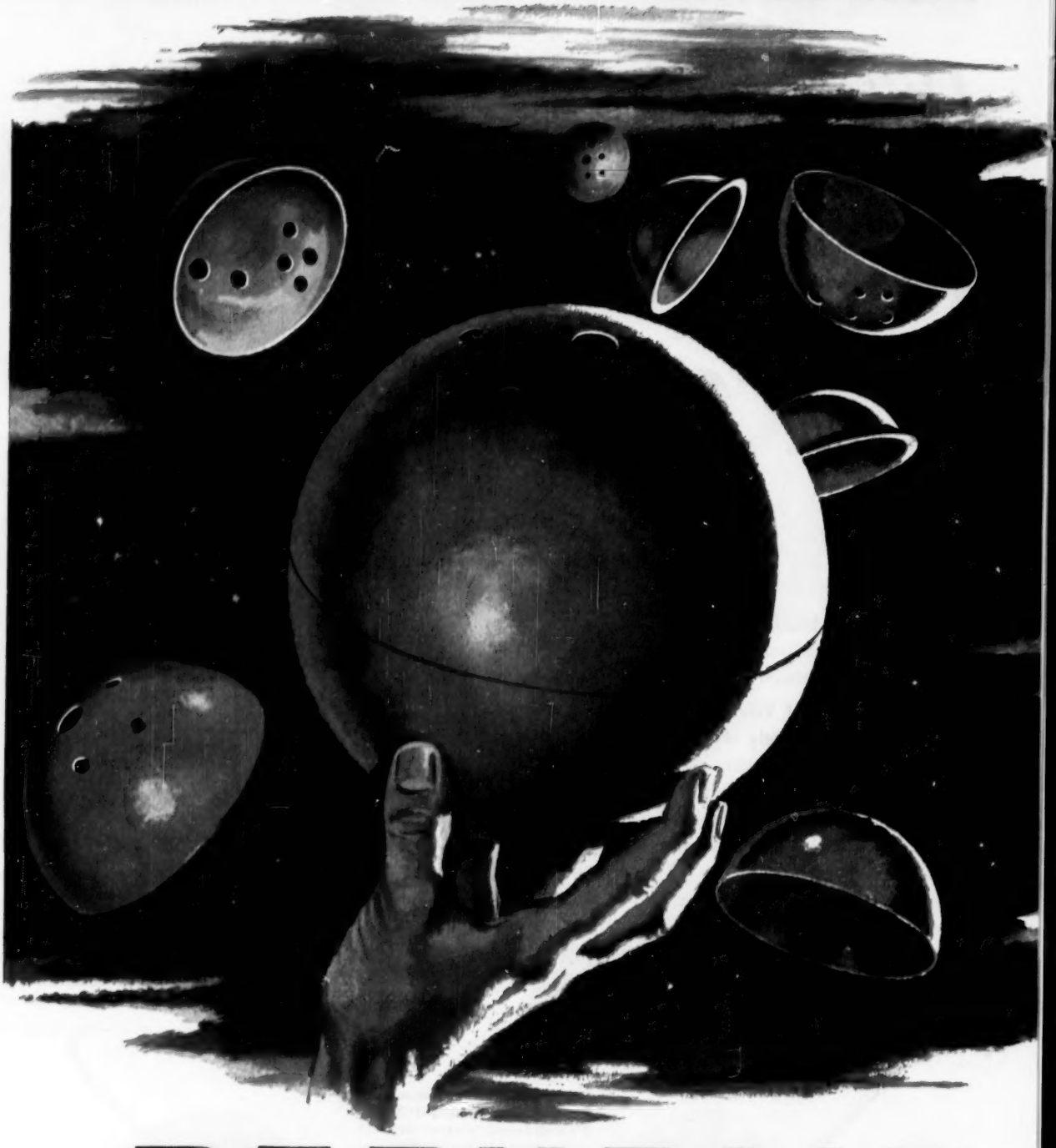

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The hemispheres are used in highly specialized aeronautical applications calling for high strength, light weight, and resistance to the severe corrosive action of liquified gases at super sub-zero temperatures.

To meet these requirements, Alloy Products Corporation, Waukesha, Wisconsin, utilizes three major advantages of Republic Titanium in fabricating the parts. (1) Titanium's lightweight advantage reduces weight without sacrifice of strength or safety. In fact, titanium offers the highest strength-to-weight ratio of construction metals. (2) This exceptional high-strength feature of titanium withstands burst pressures in excess of 2,000 lbs. p.s.i. (3) Titanium's extremely high corrosion-resistant properties defy the corrosive action to which the units are constantly exposed.

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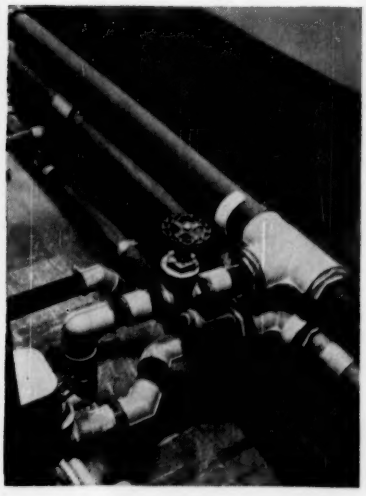
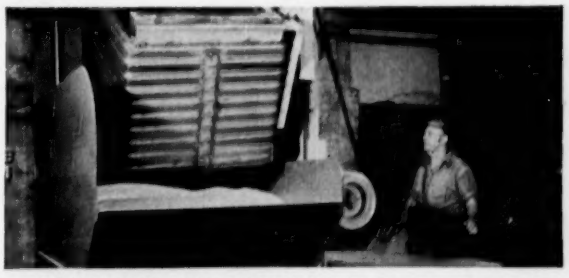
The entire fabricating operation is performed without difficulty and with little change in procedure as compared to other materials of construction.

Does this application of Republic Titanium suggest an idea for your product that needs to be strong, lightweight and corrosion-resistant? Republic Metallurgists are ready to help you apply titanium's advantages now. There's no obligation. Mail the coupon today for more information.



TOUGH, LIGHTWEIGHT REPUBLIC PLASTIC PIPE solves re-piping problem in Blaw-Knox cooling tower installation. Corrosive liquids were running up pipe replacement costs. Piping lasted little more than a year. Other pipe materials were tried, but initial costs proved too high. Then Blaw-Knox switched to Republic SRK —the corrosion-resistant plastic pipe that practically eliminates replacement costs. A similar job, installed three years ago, shows absolutely no signs of damage or wear. A substantial savings in material, installation, and replacement costs was realized. Republic SRK is lightweight, easy to carry. It is easily joined by simple solvent-welded sleeve-type fittings. It's ideal for assembling in tight or limited space. The coupon will bring you more facts by return mail.



CONTAINERS FOR BULK CHEMICAL HANDLING cut costs, save space, save man-hours, reduce loss, speed handling. This is the story behind the bulk-handling system worked out by Republic Materials Handling Engineers for The Climalene Company. Using Republic Roll-Over Boxes, one man now unloads a complete car of chemicals in less than half the man-hours required of five men under the old system. The use of bags, as well as bag breakage, and bag disposal problems have been eliminated—thus providing a substantial saving. Design and construction features of Roll-Over Boxes permit tiering to any practical height, save storage space. Your nearby Republic Materials Handling Representative has more facts on specially designed or standard handling units that cut costs and simplify operations. Or send us the coupon.

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Here is the new high standard of sodium sulfate quality achieved by exclusive West End production techniques and controls. The product is pure white and exceedingly low in heavy metal content. It is guaranteed 99½% minimum Na_2SO_4 yet actually runs 99.75% to 99.8% Na_2SO_4 typically. We invite your attention to the adjacent typical analysis and welcome your communication.

TYPICAL ANALYSIS

Na_2SO_4	99.5% or better
Na_2O	.05% max.
B_2O_3	.05% max.
NaCl	.07% max.
Insoluble	Trace
Loss on ignition	Less than 0.1%
Solution	Clear
Color	White
Fe	1 ppm
As	1½ ppm
Cu & Zn	Not detectable

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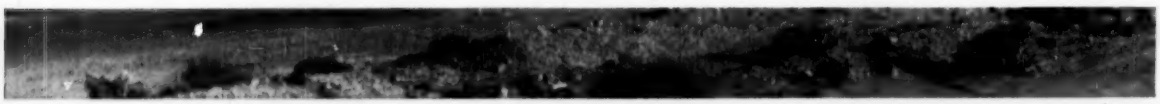
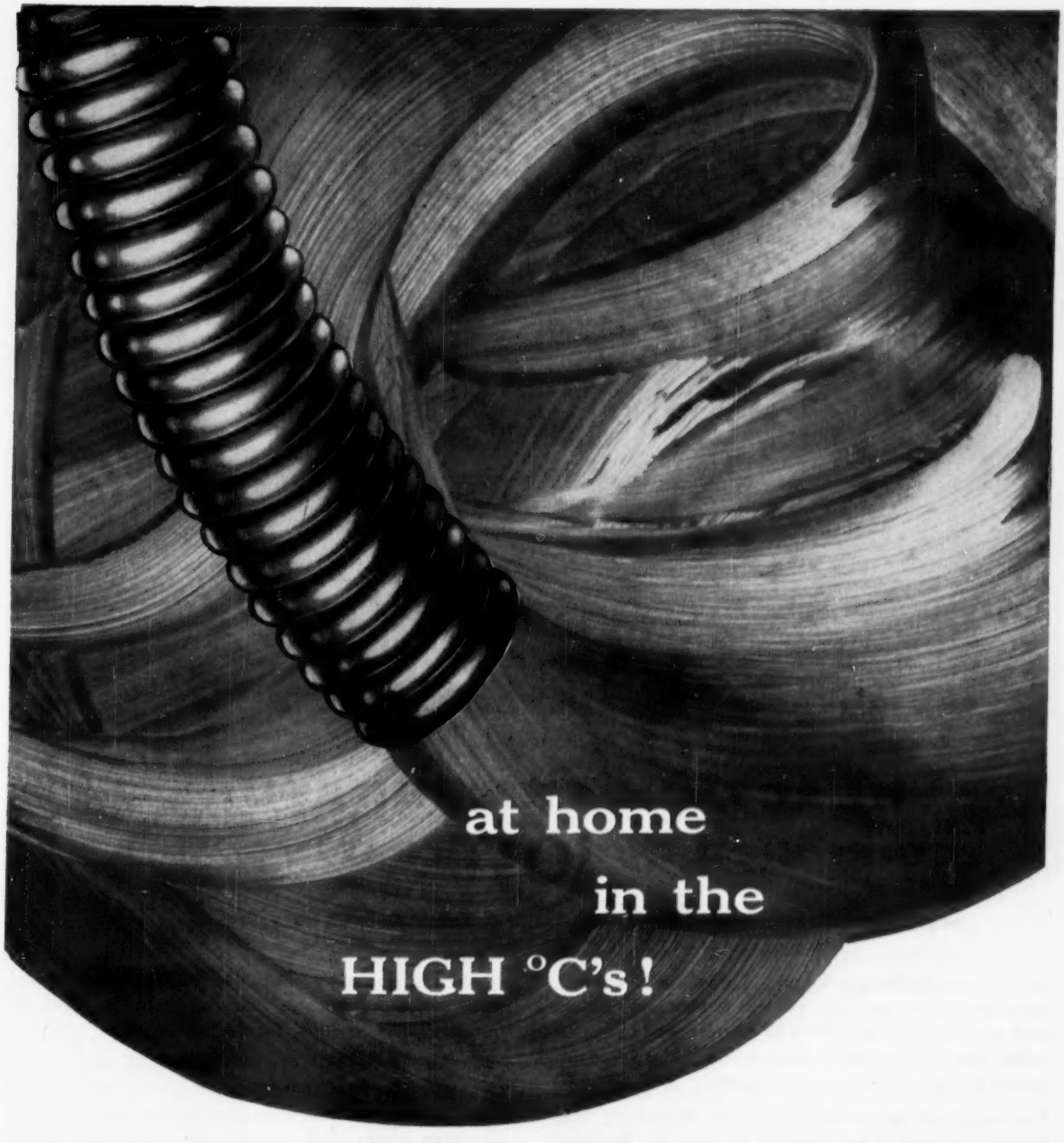


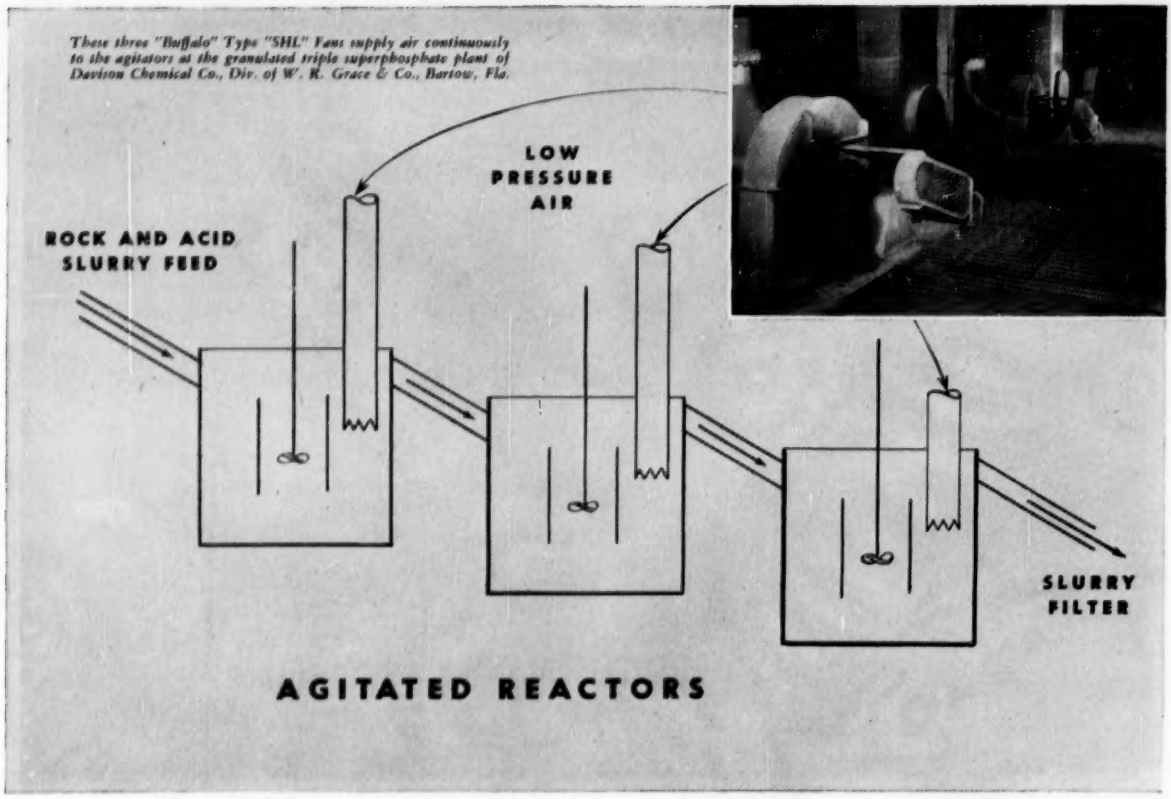


PUT ATLANTIC FLEXIBLE STAINLESS STEEL HOSE TO WORK in any inferno of high temperature and high pressure corrosive gases and liquids. It Stands Up! . . . Every inch . . . JOB TESTED & CERTIFIED . . . for unequalled leakproof qualities, durability, strength and lightness. Use it to control movement and vibration . . . correct misalignments . . . to compensate for expansion and contraction . . . in process lines . . . for loading and unloading.

Available in sizes ¼"-4" I.D. inclusive with appropriate fittings. Produced in various alloys of stainless steel —— in monel, bronze, and carbon steel. Write for Bulletin 21-A. See our Catalog in Sweet's File for Product Designers.

ATLANTIC METAL HOSE CO., INC.

329 Dyckman Street, New York 34, N.Y.


These three "Buffalo" Type "SHL" Fans supply air continuously to the agitators at the granulated triple superphosphate plant of Davison Chemical Co., Div. of W. R. Grace & Co., Bartow, Fla.
LOW PRESSURE AIR
ROCK AND ACID SLURRY FEED
SLURRY FILTER
AGITATED REACTORS

REACTION TEMPERATURE controlled by low pressure air –

– in production of granulated triple superphosphate

At one stage in the production of this highly concentrated phosphate fertilizer, phosphate rock and sulfuric acid react together in a series of pre-mixer and agitator tanks. The reaction is exothermic, and must be maintained at the optimum temperature of 70° to 75° C.

This important temperature control is dependably held by large volumes of low-pressure air from the "Buffalo" Fans, blown continuously thru the slurry in the three agitator tanks — via special distributor pipes, forming bubbles which carry away the excess heat as evaporated water. Just one more place where a modern chemical plant relies on "Buffalo" for punishing air jobs, as industry has been doing for the past 80 years.

"BUFFALO" FANS FOR CHEMICAL SERVICE include efficient central-system ventilating fans, industrial exhausters, rubber-lined and resin-bonded fiber glass fans for corrosive fumes — all built to the high standards of the "Q" Factor*. Write for recommendations on your air handling or air cleaning problem. There's a modern "Buffalo" unit to solve it to satisfaction.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

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BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

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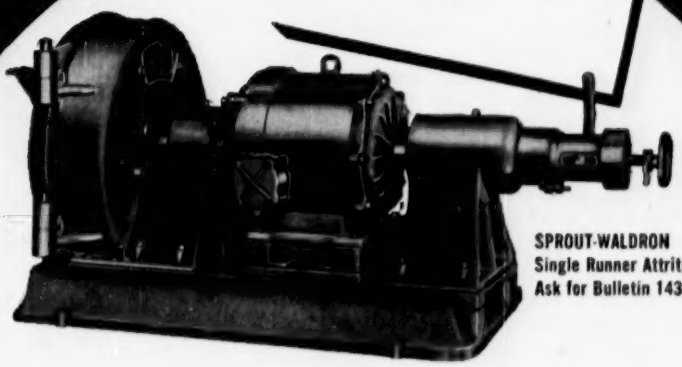
100% reliability



SPROUT-WALDRON
Single Runner Attrition Mill
Ask for Bulletin 143

...in grinders, crushers, cutters

You'll find at Sprout-Waldron the **one best** answer to your size reduction problem. Recommendations are completely unbiased because Sprout-Waldron manufactures all types of equipment that reduce materials in size.

Illustrated is probably the industry's most versatile size reduction unit. It rubs, cuts, tears, crushes, grinds, granulates, pulverizes, twists curls, hulls, and blends. Variations in product characteristics are obtainable often times with nothing more complicated than the turning of a handwheel.

In addition, Sprout-Waldron's line of size reduction equipment includes roller mills, hammer mills, burr stone mills, rotary knife cutters, saw tooth crushers, rotary crushers —all in a wide variety of styles and sizes.

Let Sprout-Waldron study your size reduction problem without cost or obligation. If we cannot solve it, you'll be directed to a manufacturer who can. Write for full details.

SPROUT-WALDRON

Manufacturing Engineers Since 1866

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Here's Why...

Silicone Insulated Transformers Provide Reliable Power Anywhere

Locate them anywhere near the load —on the floor, a balcony or wall . . . dry-type transformers insulated with Dow Corning Silicones are lightweight, space-saving and easy to install. They fit into any plant layout. And equally important, they cost less to install, less to maintain, far less in the long run!

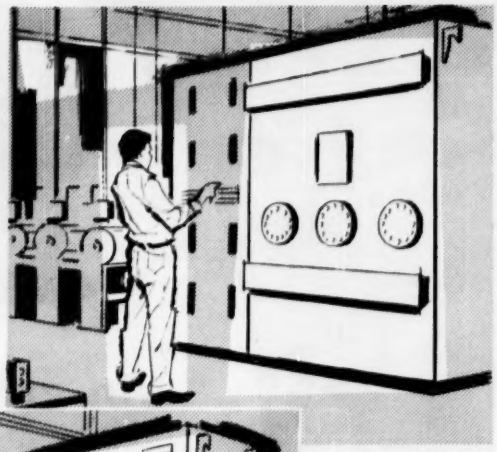
Easy, low-cost installation. Simply connect the necessary leads and throw the switch! Neither sealed nor open type silicone-insulated transformers require costly vaults, barriers or ventilating fans. And they don't contain liquids that can burn, explode or give off toxic fumes. They're completely dry, completely safe.

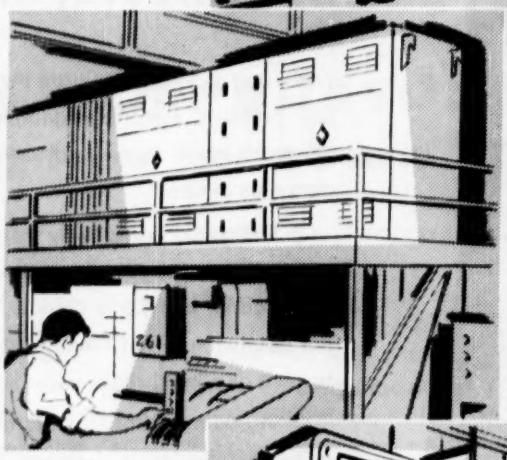
New freedom from maintenance. With no liquids to maintain or toxic fumes to guard against, you install dry-type transformers and virtually forget them. Even in open-type transformers, silicone insulation assures reliable power despite contaminated atmospheres, dust, dirt, moisture or high ambients.

Maximum reliability. Dow Corning silicone insulation has sufficient thermal capacity to handle temporary overloads up to 25% above rated capacity. This extra capacity assures the ultimate in uninterrupted, reliable power for automation . . . continuous processing . . . and all plant functions.

Send today for a list of equipment manufacturers who supply Dow Corning silicone-insulated dry-type transformers.

ON THE FLOOR
maximum safety; freedom from maintenance; easy to install





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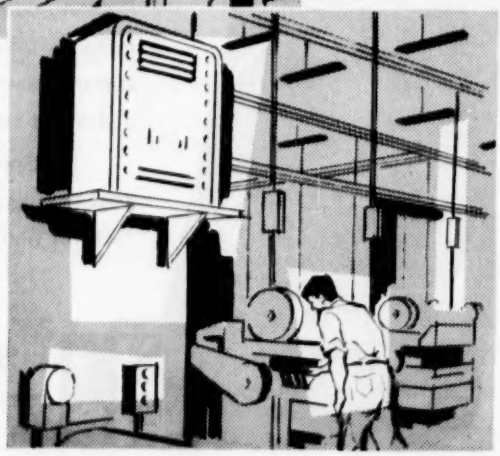
15% lighter than next lightest type; save floor loading

OR WALL
lightweight wall or platform mounted units save floor space



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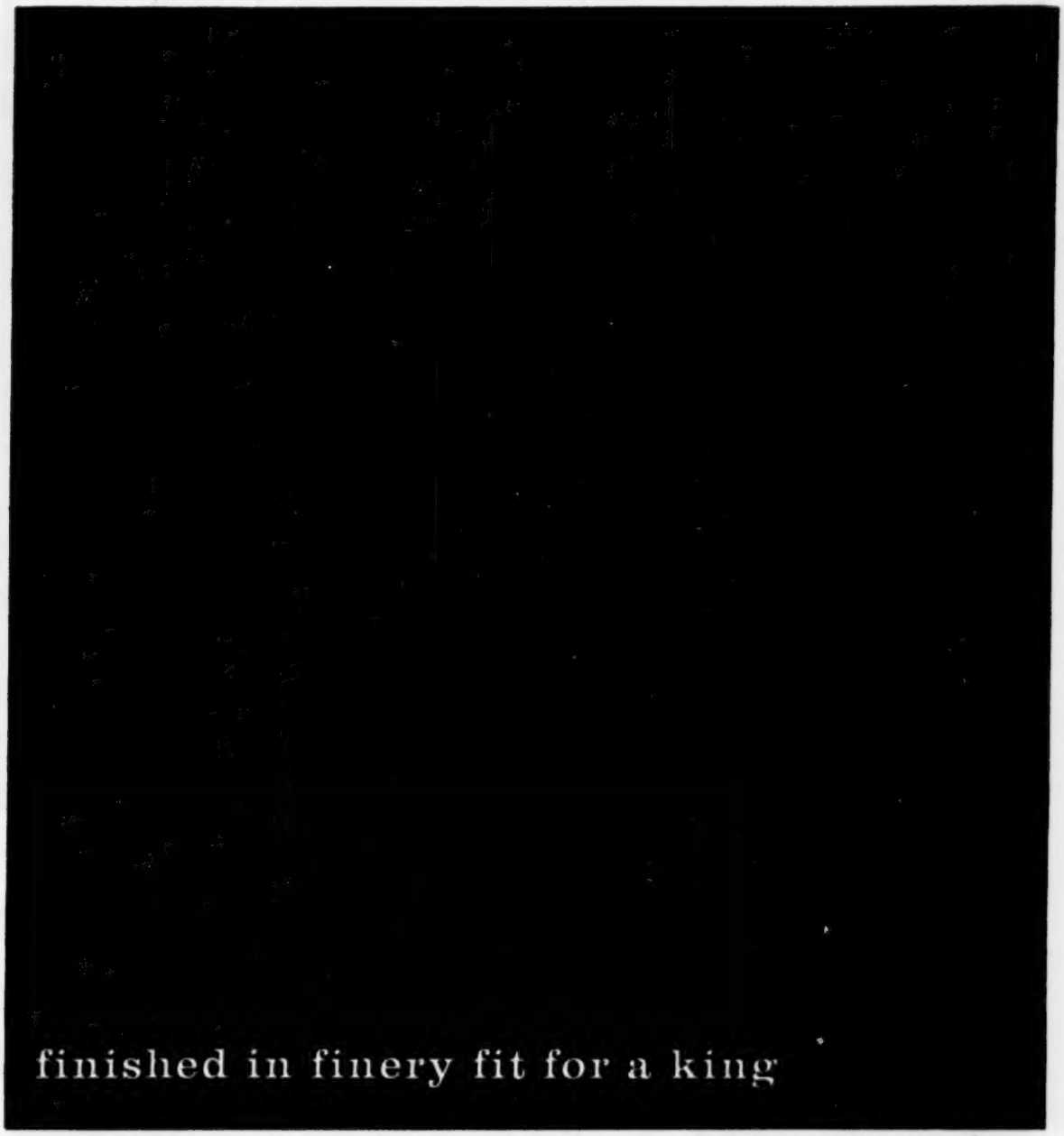

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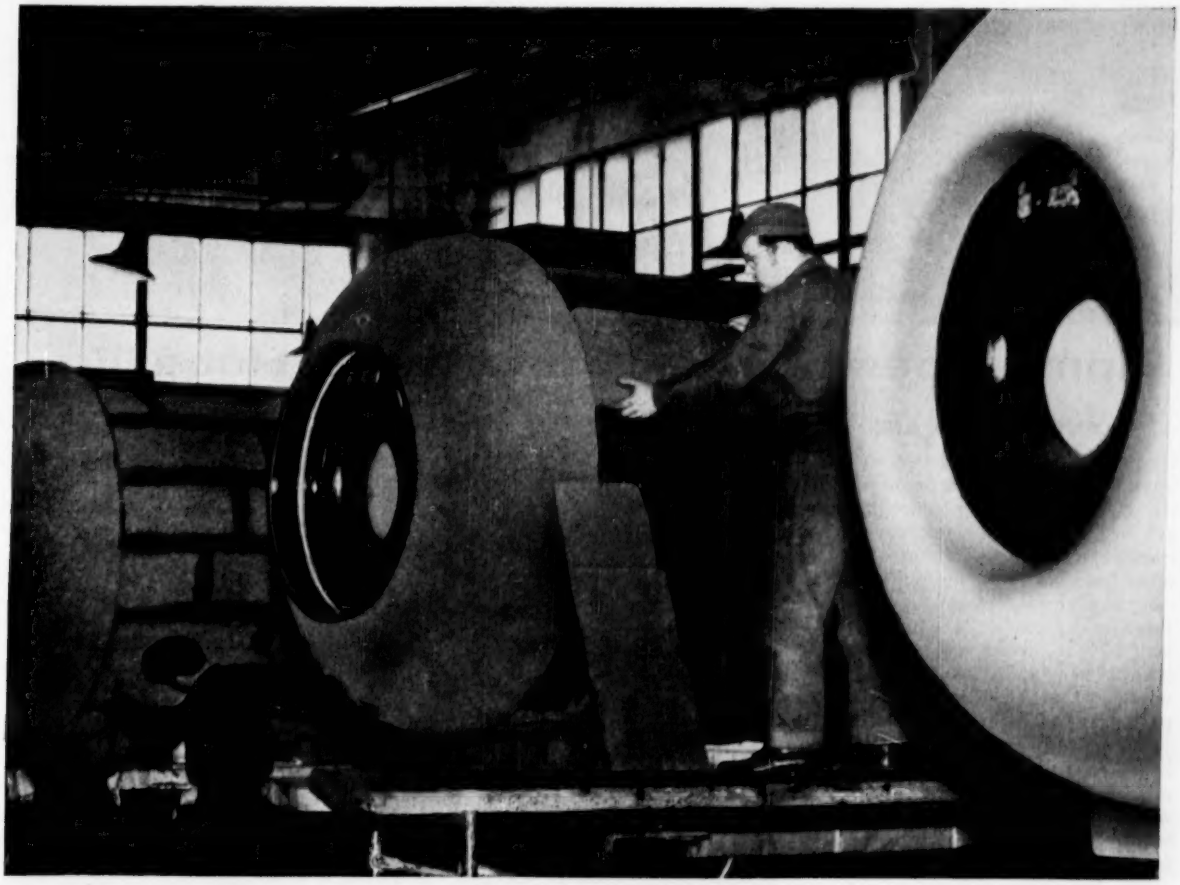

Cork Overcoat for a CO_2 Vessel

We've never been inside a loaded CO_2 vessel, but we know it has to be cool—real cool.

Kept cool and under pressure CO_2 remains in a liquid state, but a temperature rise causes a pressure build-up resulting in loss of product which is highly undesirable. The men in the photo above are helping these vessels into a cork overcoat. First we fabricated the vessels—complete with refrigeration coils—then applied the cork insulation. Auxiliary equipment such as refrigeration unit, vaporizer, valves and safety devices were assembled into a compact control panel mounted to the vessel. So you see, fabrication is only a part of the work we do at Chicago Steel Tank Company.

Throughout more than 50 years, clients in many industries have utilized our versatile manufacturing experience and facilities to produce other than the usual fabricated products. We can do the same for you.

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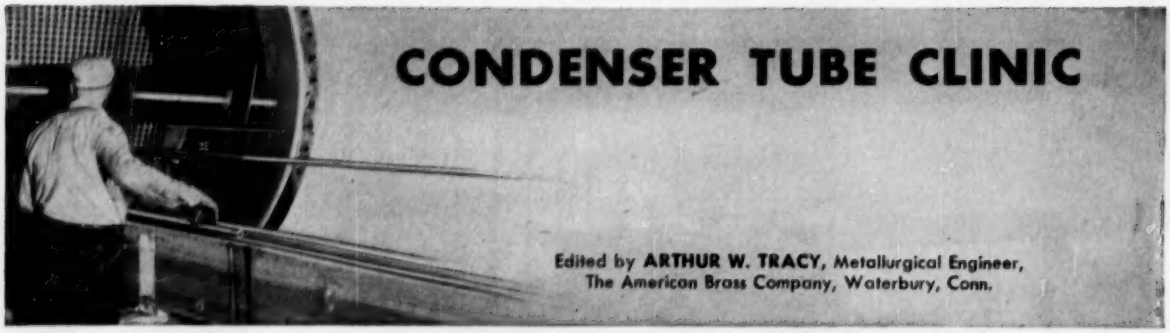


CONDENSER TUBE CLINIC

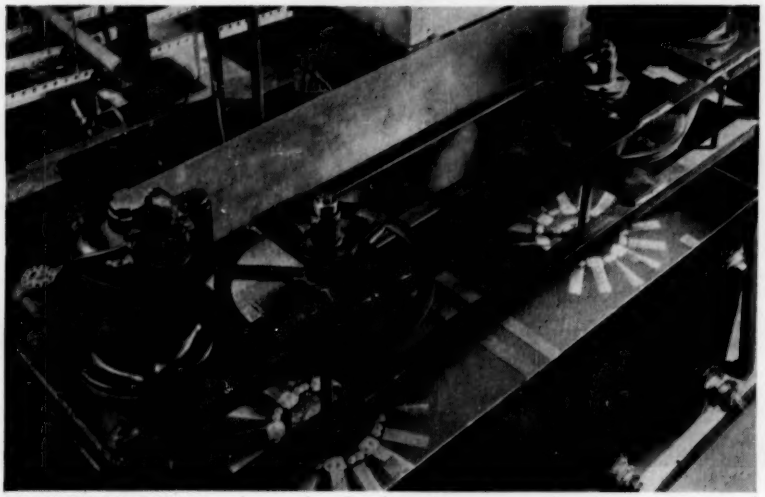
Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

Some Operating Factors that affect tube life

OXYGEN AND AIR

Oxygen in the air in cooling waters is a necessary factor for corrosion to occur, but normally the presence of oxygen in solution does not cause rapid corrosion of condenser tubes. On the other hand, air in the form of bubbles can cause rapid corrosion of condenser tubes under conditions where turbulent flow is present. Air bubbles of harmful size may be produced by whirlpools in the intake tunnel, leaky packing glands on pumps, and at projections in injection pipes or water boxes. Any condition that will produce a negative pressure at some point along a tube, such as a long outlet water leg from a condenser, can also cause air bubbles to form with consequent local rapid pitting.

Sea-chest strainers may be another source of air bubbles unless designed to allow nonturbulent flow of water.



EQUIPMENT FOR TESTING condenser tube alloys for resistance to corrosion. Specimens are rotated under water to determine the effect of velocity. Further information is obtained by testing actual condenser tubes in operating condensers.

STRESSES

Stresses capable of causing stress-corrosion cracking of some alloys can be set up in tubes by thermal expansion pressure or from the rolling-in of tubes into tube sheet. It is not usually possible to change operating conditions to reduce stresses, but failures from stress-corrosion cracking can be minimized by the careful rolling-in of tubes to avoid developing high longitudinal stresses, especially when both ends of the tubes are expanded into the tube sheets.

Cyclic stresses due to vibration can cause fatigue failure of condenser tubes, and such a failure can be extremely rapid even when only tiny corrosion pits have developed on the wall of the tube. If the source of the vibration cannot be removed, the vibration of the tubes can sometimes be dampened.

GALVANIC EFFECTS

The galvanic corrosion of condenser tubes is seldom a problem because the choice of metals is usually such that the tubes are galvanically positive (cathodic) to the tube sheets and the water boxes. Any slight galvanic corrosion on tube sheets and water boxes due to their being anodic to the tubes is insignificant because of their relatively great thickness.

Zinc or magnesium sacrificial anodes are frequently placed in condenser water boxes that have been treated with paint or an organic coating to protect the iron or steel from accelerated corrosion at "holidays" or pinholes in the coating. Such anodes will generally protect the ends of the tubes from corrosion for a short distance, usually equivalent to about two tube diameters.

There is considerable experience indicating that bare iron or steel water boxes not only act as sacrificial anodes in protecting the ends of condenser tubes, but also that the corrosion products from these water boxes mixing with the tube corrosion products help build a more protective film along the whole length of the tube. Iron anodes in painted water boxes will be a source of iron compounds but will have little effect in galvanically protecting water boxes at the discontinuities in the paint film. When a new set of tubes is started in service in an old condenser where surfaces are well scaled, the use of new, clean iron anodes should aid in a more rapid formation of protective film on the tubes.

TECHNICAL HELP IN SELECTING TUBES

Your situation may require special consideration and analysis. We are always ready to help and advise in the selection of the right alloy to give best service. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8787

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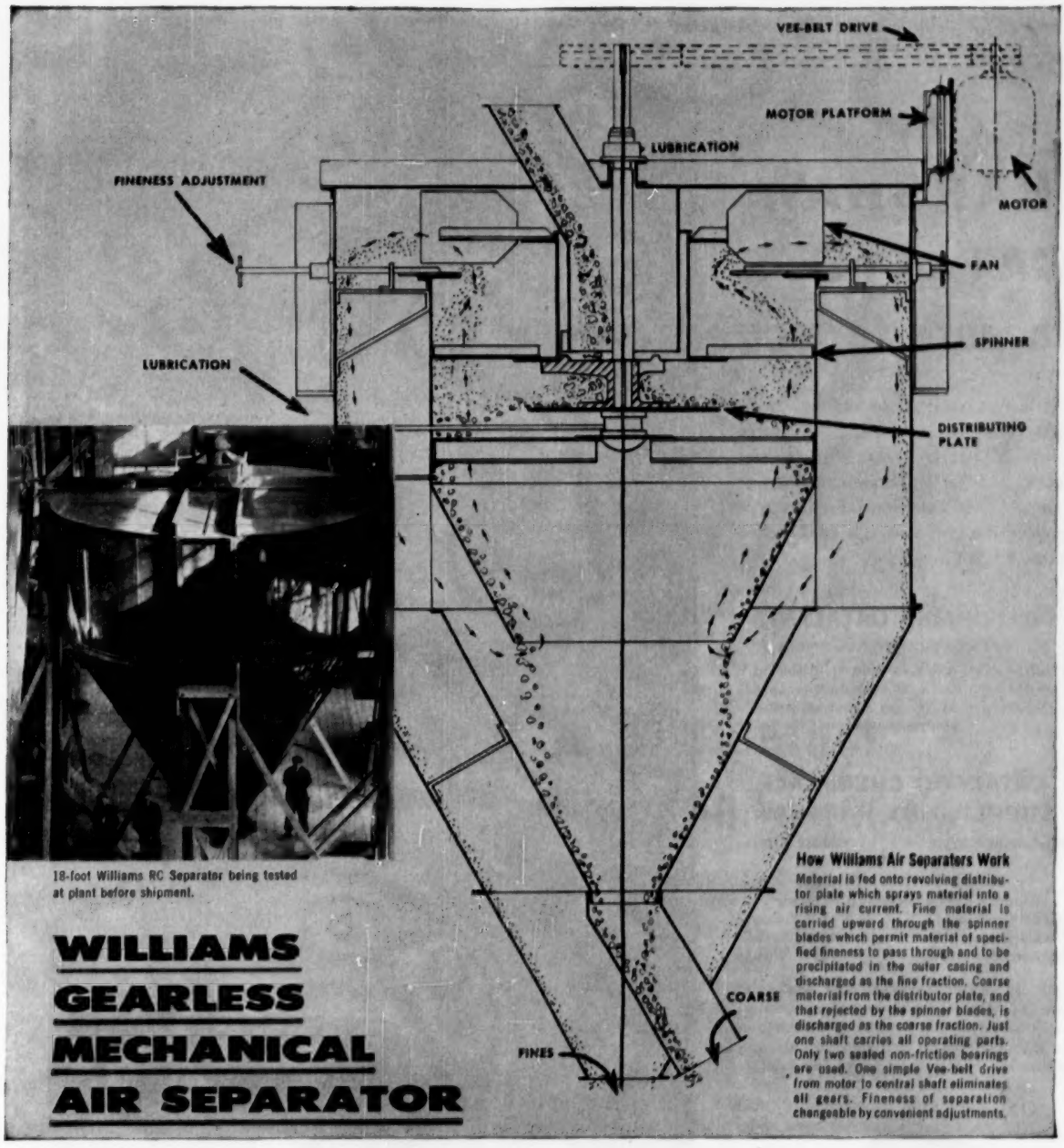
TUBES AND PLATES

for Condensers and Heat Exchangers

Made by **THE AMERICAN BRASS COMPANY**



18-foot Williams RC Separator being tested at plant before shipment.

WILLIAMS GEARLESS MECHANICAL AIR SEPARATOR

How Williams Air Separators Work

Material is fed onto revolving distributor plate which sprays material into a rising air current. Fine material is carried upward through the spinner blades which permit material of specified fineness to pass through and to be precipitated in the outer casing and discharged as the fine fraction. Coarse material from the distributor plate, and that rejected by the spinner blades, is discharged as the coarse fraction. Just one shaft carries all operating parts. Only two sealed non-friction bearings are used. One simple Vee-belt drive from motor to central shaft eliminates all gears. Fineness of separation changeable by convenient adjustments.

20 To 325 Mesh Separations—Trouble-Free Gearless Operation

For removing fines from coarsely ground material or for making separations of fine material (the separations ranging from 20 to 325 mesh), Williams Mechancial Air Separators provide the lowest cost, maximum production equipment yet devised. Separation is by specific gravity and no fine delicate screens are employed. Output is unusually high even for fine separations. Construction is heavy duty throughout with heavy steel plate casing, simple gearless drive and heavy internal construction. Only two anti-friction bearings are used. They are enclosed in dust-proof and moisture-proof housings. All sizes permit adjustment for wide variation in fineness of separation. Let us send you complete information.

9 Standard sizes. Capacities, ¼ ton to 75 tons hourly.

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Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.

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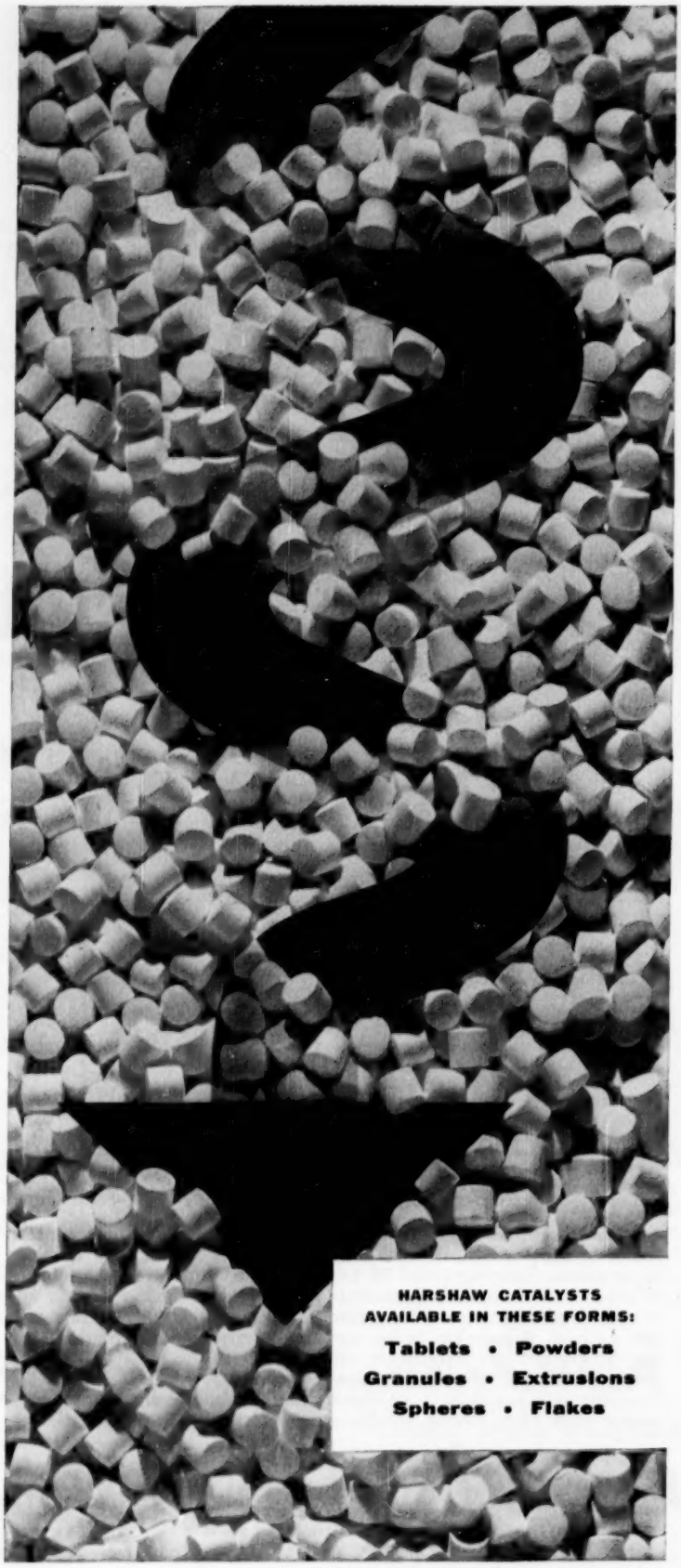

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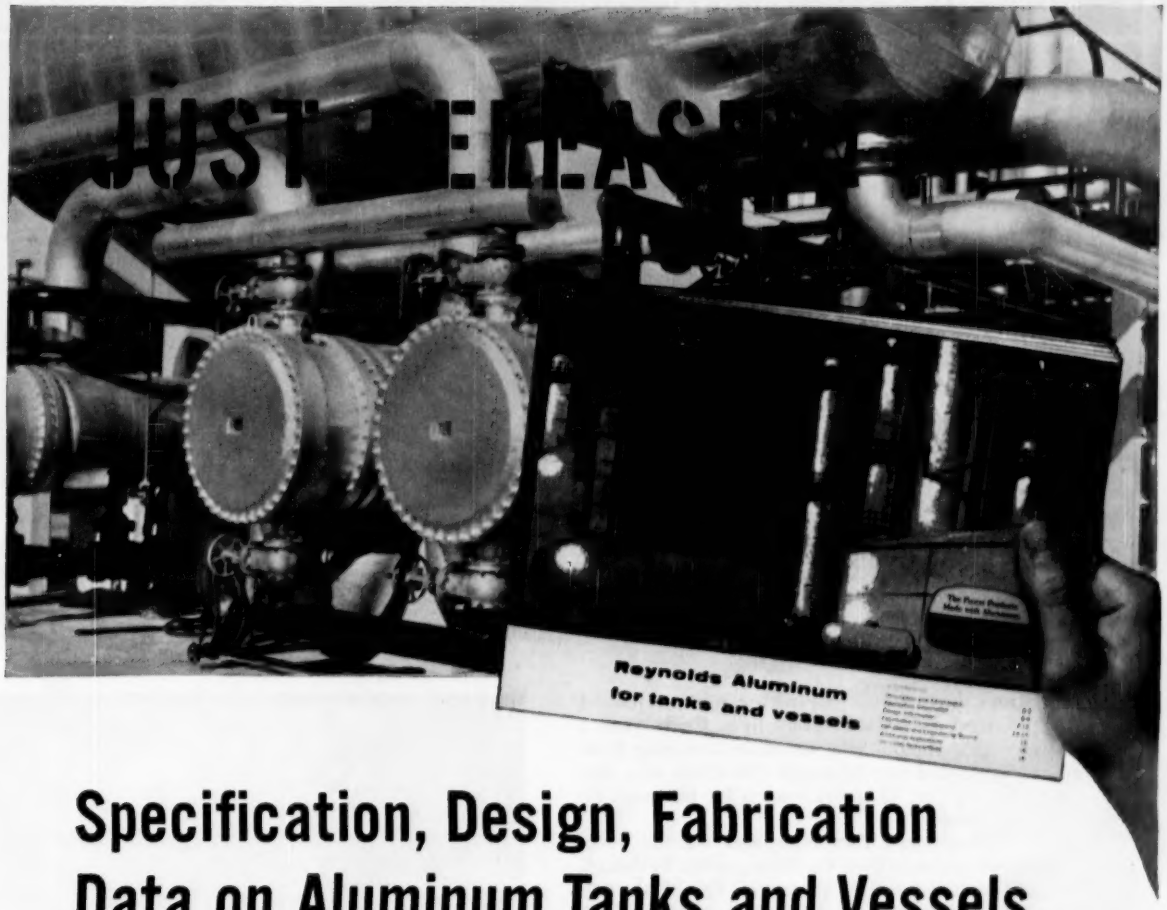

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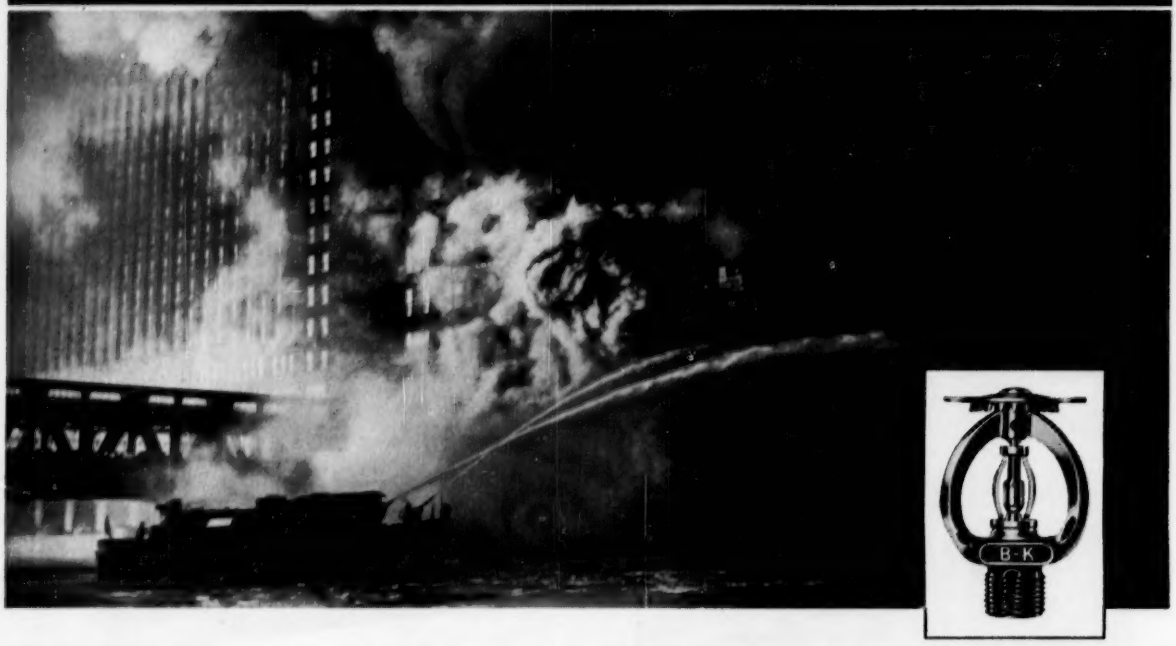
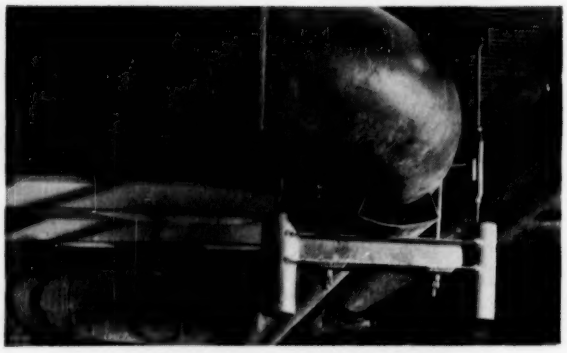


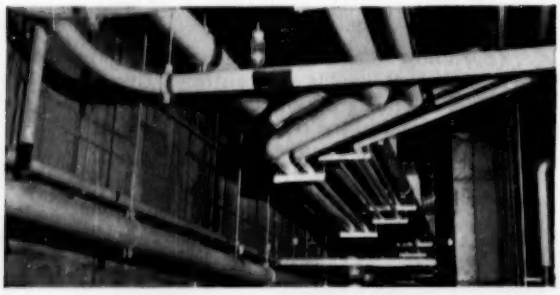
A Blaw-Knox automatic sprinkler system could have prevented this disastrous fire. Each year a serious fire strikes one out of seven manufacturing firms in this country. And out of every 100 firms who lose their records in a fire, 43 never reopen for business. So why take any chances.

Blaw-Knox engineers, fabricates and installs automatic sprinkler systems that are always alert to detect, confine and quench a fire at its origin. Qualified engineers custom-design systems that meet individual requirements—and fulfill all insurance standards and municipal codes. A Blaw-Knox automatic sprinkler system pays for itself in a few years through savings in reduced insurance premiums.

Let a Blaw-Knox fire-protection engineer study your needs, submit a layout and estimate, and tell you how you can pay for the system on our lease or deferred payment plan. For more complete information, write for Bulletin No. 2426—"Fire Can Destroy Your Business."



Blaw-Knox trapeze functional spring hangers, with the patented internal swivel action, support power piping in new generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. For further information, send for Catalog No. 54.



High temperature, high pressure oil tunnel piping in large steel mill is typical of many piping systems prefabricated and erected by Blaw-Knox. Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available to you. Let us know your requirements and we will provide the service you need. For additional information, write for Bulletin No. 2443—"Piping for Industry."

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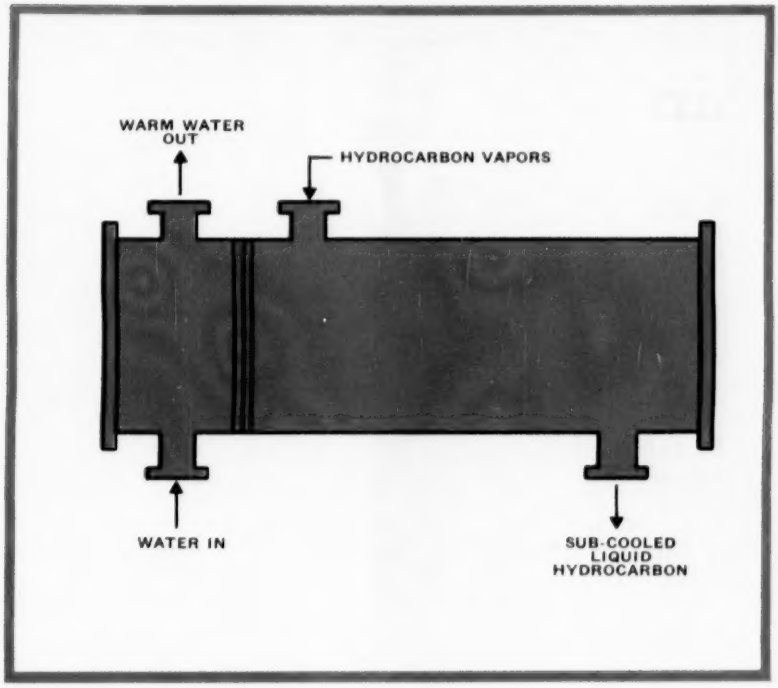
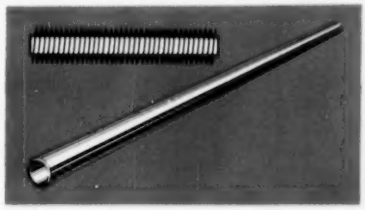


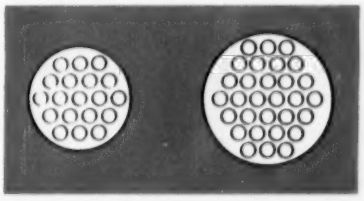
HERE'S THE WAY TRUFIN TYPE S/T HELPS YOU SAVE

You know what they say—about a good picture taking the place of a thousand words. Well, most of the time we don't agree with this—but the three drawings below are the exception to the rule. Look them over and see for yourself exactly how Wolverine Trufin Type S/T can help you improve heat transfer performance.

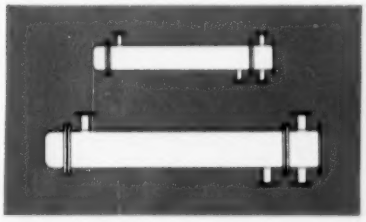
This much Trufin has the same surface area as this much plain tube...



Which means smaller shells . . .



And smaller units with greater capacity



SAVES MONEY, TOO:

Use of WOLVERINE TRUFIN® Boosts Condenser Heat Load

By Ernest Dodd

Throughout industry—wherever heat transfer is a necessity—more and more engineers are finding that the answer to increased heat transfer performance lies in the use of Wolverine Trufin Type S/T—the integrally finned condenser tube.

As another perfect example of this, consider the results obtained by processing engineers in a large Eastern refinery, when they retubed a hydrocarbon side cut condenser with Wolverine Trufin Type S/T.

In its prime surface form the unit required 476 tubes ¾" O.D. in 16' lengths. When retubed with Trufin Type S/T, exactly the same number of tubes of the same length and O.D. were used. *Heat duty, however, immediately shot up by 30 to 35%—a gratifying increase indeed.*

There is no particular secret or magical formula connected with Trufin's ability to extract more BTU's per foot of tube. Its success is in its extended surface—gained through its integral fins which are actually extruded from the tube wall. Because of these fins, Trufin has approximately 2½ times more outside surface area than does an equivalent piece of plain tube. More outside surface area, of course, means that you can pack more heat transfer surface into a given space thus boosting the heat performance of existing units.

In addition to boosting capacity, Trufin Type S/T also saves you money. Because it is completely interchangeable with plain tube there is little unit modification required — you simply insert Trufin condenser tubes into the bundle and roll it into the tube sheet in the regular manner, using standard tools and retubing techniques.

Here's a sure-fire method for boosting throughput, saving space and cutting costs—all at the same time.

If your company hasn't as yet used Wolverine Trufin Type S/T condenser tubes why don't you suggest them.

NEW BOOK—FREE!

Wolverine's new "Comparative Heat Exchanger Costs Book" is well worth adding to your heat transfer file. Prepared by experts it graphically presents cost breakdowns and actual comparisons between the use of plain tube and integrally finned tube in the design of heat transfer equipment. Write for your copy—TODAY!

CALUMET & HECLA, INC.
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WOLVERINE TUBE DIVISION
FOREST INDUSTRIES DIVISION
CALUMET & HECLA OF CANADA LIMITED
CANADA VULCANIZER AND EQUIPMENT COMPANY LIMITED

WOLVERINE TUBE

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EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK

Believe it or not...

it's integral!

Varying temperatures ... fluctuating pressures ... constant vibration. None of these can affect the inherent stability of Wolverine Trufin' —the one-piece, finned condenser tube.

The fins of Trufin are squeezed right from the tube wall, are completely integral with the tube itself. That means longer on-stream time—more "mileage" when the going is tough.

Trufin can step up the capacity of your existing unit, when revamping, or can permit the design of a smaller unit (with a bigger punch!) when new heat exchangers are considered. Replace prime surface tube with Trufin Type S/T (low finned) in water-cooled condensers. Specify Trufin Type H/R (high finned) for air-cooled applications. Investigate the Trufin story—NOW! Write for the Trufin Catalog.

Wolverine Trufin is available in a wide range of sizes and types, in copper, copper-base alloys, aluminum and electric-welded steel.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario

BUY WOLVERINE TUBE—IT'S MADE IN AMERICA

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Some of the many available desiccants

It takes an expert prescription to dry gas properly . . .

Come to Kemp

Kemp Oriad Dryer protects pneumatic instrument board at Spencer Chemical in Charlestown, Ind. The unit has needed only minor service since its installation in 1950 and has given top performance at all times.

Over 20 *different* desiccants . . . each with its own particular properties and uses. It takes experience to choose the right one and engineer it into a drying system that will exactly meet your needs.

Kemp offers you that experience . . . almost a quarter-century in designing and building drying apparatus. Kemp engineers combine the right equipment and the right desiccant into a unit that brings you dependability, ease of maintenance, and simplicity of operation. For any use . . . guarding pneumatically operated instruments and tools . . . drying process gasses and inerts for blanketing and purging . . . pressurizing anhydrous liquids . . . liquid drying or any of a host of other applications . . . a Kemp Oriad or Convection type dryer will give you high efficiency drying at low cost.

To improve performance and cut costs in your operation, have Kemp engineers recommend a system for your plant. Your Kemp Representative will give you detailed information, or write direct for Bulletin D-100. The C. M. Kemp Mfg. Co., 405 East Oliver St., Baltimore 2, Md.

Kemp Convection Dryers

Kemp Inert Gas Generators

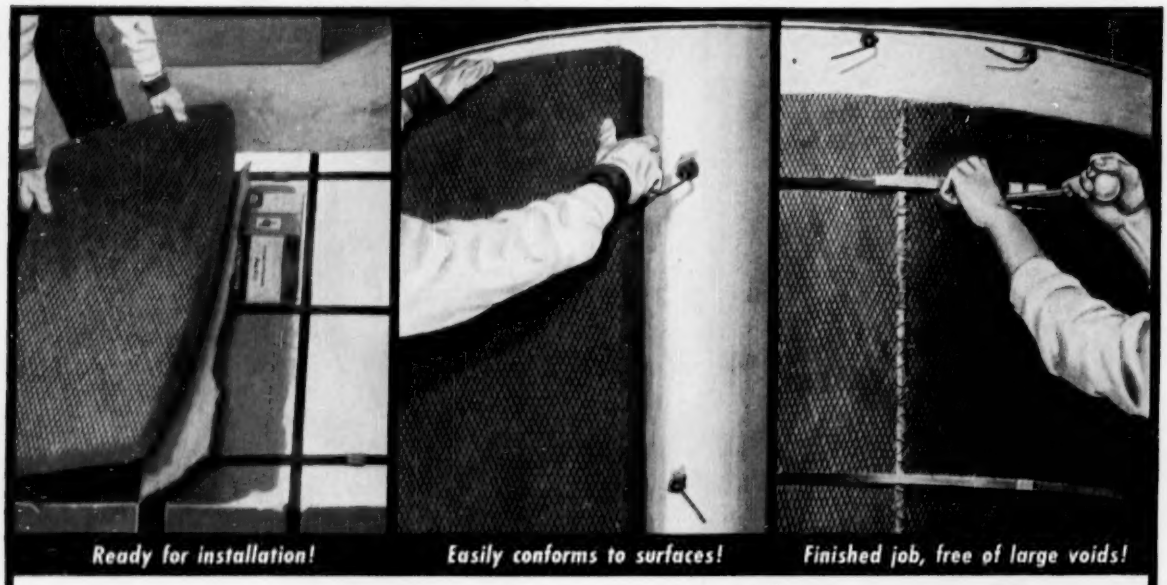
KEMP OF BALTIMORE

Kemp Industrial Carburetors

Kemp Oriad Dryers

FACTORY FABRICATED TO RIGID SPECIFICATIONS!

EAGLE-PICHER BLANKET INSULATION



Ready for installation! *Easily conforms to surfaces!* *Finished job, free of large voids!*

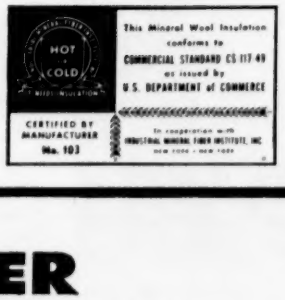
- Copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep blankets firm but flexible.
- Eagle-Picher mineral wool evenly dispersed over entire insulating area of each blanket.
- Completely free of large voids usually found in field-made blankets where insulation is simply packed in place.
- Smooth edges butted tightly together eliminate cracks and loose joints.
- Quickly applied to flat or slightly curved surfaces or any large equipment—or cut to fit irregular areas.
- Maximum thermal efficiency at temperatures as high as 1200 F.

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

FREE SAMPLE!

Write today!

Eagle-Picher Blanket Insulation conforms to Commercial Standard CS-117-49.



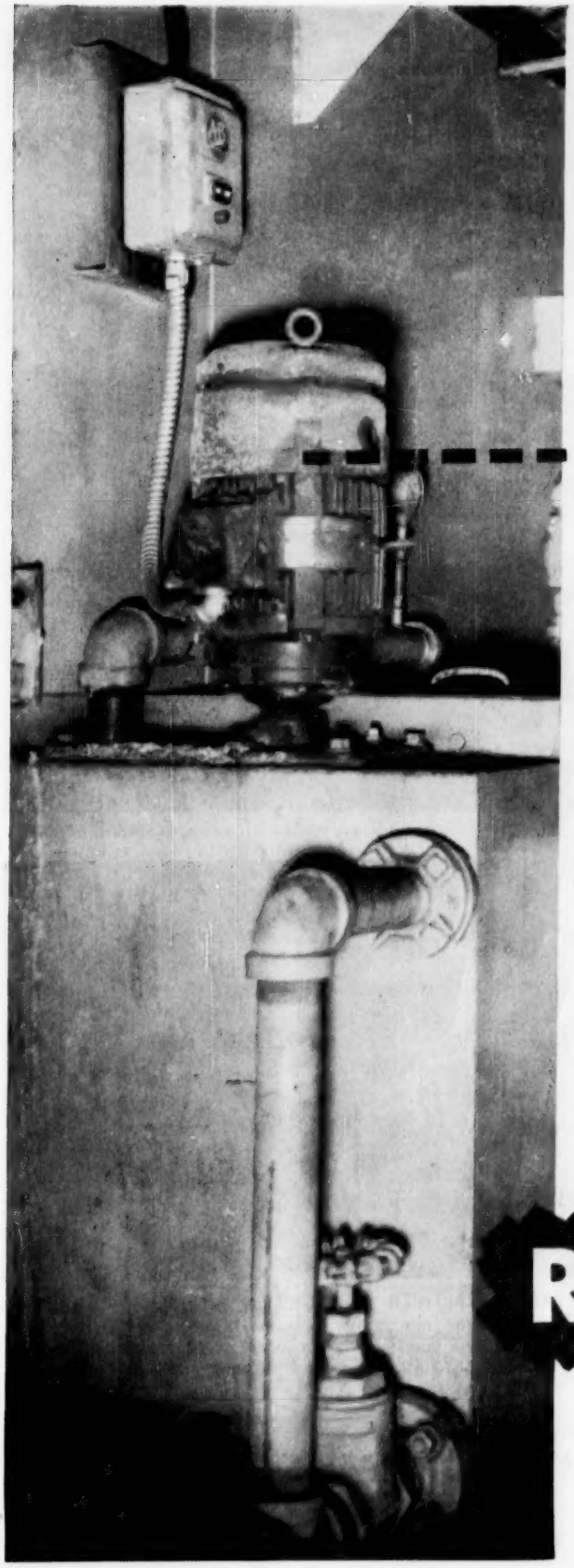
Since 1843

EAGLE PICHER

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(*Member of Industrial Mineral Fiber Institute*)



RELIANCE solves motor corrosion problem

This Reliance Corrosion-Proof Motor is operating a pump which circulates cleaning solution through a tank containing metal parts. The motor is subjected to corrosive vapors and liquids each time a basket of parts is removed. BUT THIS MOTOR WILL NOT CORRODE.

The solid cast-iron housing, including the fan cover, will withstand corrosive service indefinitely. Wiring identification is preserved on a stainless steel name plate. A threaded outlet is provided on the water tight conduit box, and motor leads are molded into a neoprene gasket that completely seals off the windings from the conduit box. A neoprene or non-ferrous shaft slinger seals the only other frame opening.

These and many other features give you a motor with a built-in corrosion protection. Why not install this superior design now and save many replacement dollars in the years ahead.

Write for bulletin B-2406 for complete design details.

B-1004

Zone 17, 337A

RELIANCE ELECTRIC AND ENGINEERING CO.

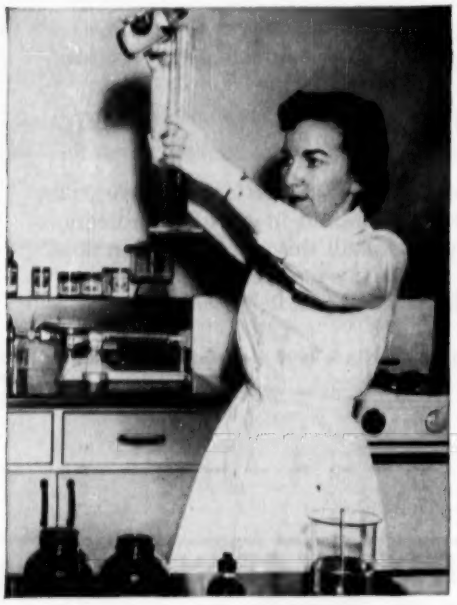
Dept. 1311A, Cleveland 10, Ohio
Canadian Division: Welland, Ontario

Sales Offices and Distributors in Principal Cities

HOW HERCULES HELPS...

PRODUCE STANDOUT PACKAGES—A long list of Hercules chemicals helps to make better boxes, bags, and cartons for stores and industry. Hi-fax®, Hercules' new type polyethylene, wet-strength resins, fortified size, wax emulsions, and ethyl cellulose hot-melt adhesives, all contribute importantly to improved packaging. Hercules® CMC used in paper making results in better gloss printing with less ink. In the inks themselves, Vinsol®, Poly-pale®, and other Hercules resins are used to meet specific printing requirements.

MAKE FOODS TASTE BETTER—In the modern, well-equipped kitchens at the Hercules Research Center, trained food technologists continually work with processors to determine proper use levels for the complete line of flavoring agents, taste intensifiers, and meat tenderizers produced by Huron Milling Division.



KEEP CATTLE HEALTHIER—Ticks, horn flies, stable flies, and other insect pests keep beef cattle from putting on weight. Livestock spray formulations based on toxaphene insecticide control these pests, are approved by the USDA, and meet the rigid specifications of the Food and Drug Administration.

HERCULES

HERCULES POWDER COMPANY
INCORPORATED
900 Market St., Wilmington 99, Delaware

CHEMICAL MATERIALS FOR INDUSTRY

657-9

HUGE METHANE COLUMN

exemplifies

SIZE AND EXACTING DETAIL OF

PROCESSING EQUIPMENT

by

STRUTHERS WELLS

Built in three sections, each requiring a separate railroad car for shipping, this huge methane column is 98' long x 64" I.D. (maximum). This is another example of the scope of Struthers Wells engineering, research and fabricating facilities —to produce processing equipment to your exact requirements —regardless of size or code specifications.

Write our nearest sales office or direct to our plant, for prompt attention on process equipment needs.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

STRUTHERS WELLS *Corporation*

TITUSVILLE, PA.

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Plants at Titusville and Warren, Pa.

Offices in Principal Cities

HOW HERCULES HELPS...

PRODUCE STANDOUT PACKAGES—A long list of Hercules chemicals helps to make better boxes, bags, and cartons for stores and industry. Hi-fax®, Hercules' new type polyethylene, wet-strength resins, fortified size, wax emulsions, and ethyl cellulose hot-melt adhesives, all contribute importantly to improved packaging. Hercules® CMC used in paper making results in better gloss printing with less ink. In the inks themselves, Vinsol®, Poly-pale®, and other Hercules resins are used to meet specific printing requirements.

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HERCULES

HERCULES POWDER COMPANY
INCORPORATED
900 Market St., Wilmington 99, Delaware

CHEMICAL MATERIALS FOR INDUSTRY

G87-9

HUGE METHANE COLUMN

exemplifies

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PROCESSING EQUIPMENT

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PROCESSING EQUIPMENT DIVISION

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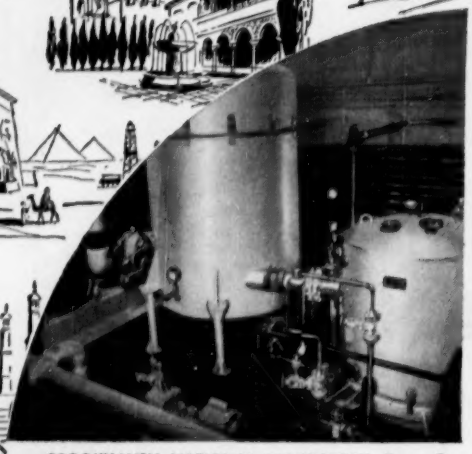
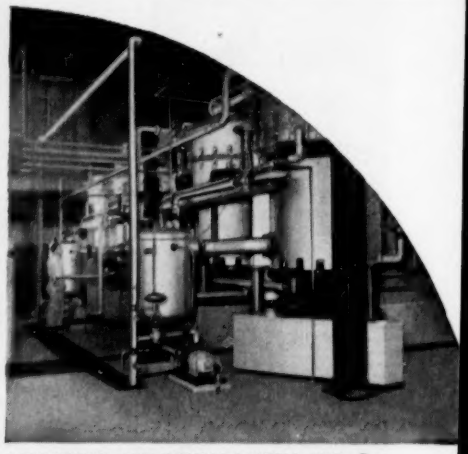
CLEAVER-BROOKS
VAPOR COMPRESSION EVAPORATORS

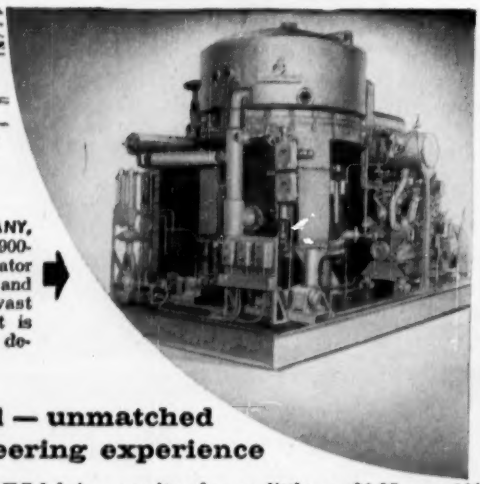
Field-proved by 12 years of service in 22 countries



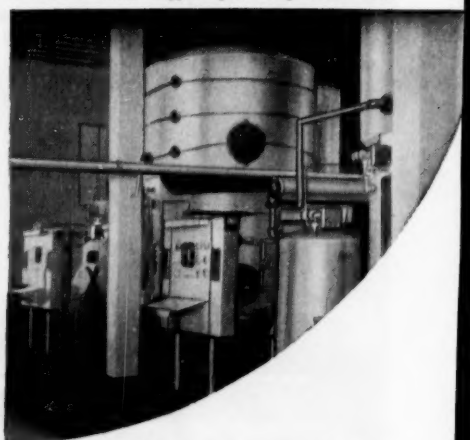
BROOKHAVEN NATIONAL LABORATORY, Long Island, N. Y., uses this 300-gph vapor compression plant to concentrate radioactive waste, thereby easing a hazardous storage problem.



ARROWHEAD AND PURITAS WATERS, INC., Los Angeles, Calif., produces chemically pure, USPH water for drinking and pharmaceuticals in this 100,000-gpd vapor-compression unit.



SAHARA PETROLEUM COMPANY, Alexandria, Egypt, employs a 900-gph vapor compression evaporator of this type to supply drilling and exploration camps with vast amounts of fresh water. Unit is typical of complete "packages" delivered to installation site.



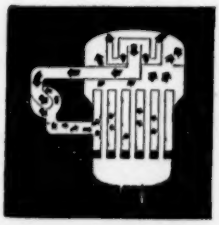
TOWN OF SALINAS, Ecuador, receives its entire residential fresh water supply from two 2100-gph vapor compression evaporators. This life-saving water supply (100,000 gpd) saved the town from being abandoned.

Leader in its field — unmatched application engineering experience

An oil camp in Egypt...an AEC lab in Long Island . . . a pharmaceutical plant in California...a coast town in Ecuador. *Just four of thousands* of Cleaver-Brooks vapor compression evaporators that are proving the economies of highly efficient operation.

Drawing from any raw water supply, sea water or even radioactive waste — these thoroughly field-tested units automatically produce distillate of highest purity, for as little as $1.25 per 1000 gallons of potable water.

Cleaver-Brooks is widely recognized as a leader in evaporation engineering — consistently solves pure water problems . . . with equipment designed for *most economical* operation. In addition to vapor compression evaporators, users also have a choice of multi-effect, flash and waste heat units in a wide range of capacities.



Vapor compression, the world's most efficient evaporation plant

Latent heat is constantly reclaimed by the compressor or "heat pump" and recycled through the evaporator. Up to 300 pounds of fresh water can be produced for every pound of diesel fuel used. Electric and steam-driven units consequently are economical to operate.

Cleaver Brooks

BUILDERS OF EQUIPMENT FOR THE GENERATION AND UTILIZATION OF HEAT AND POWER

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NEW! direct tank-mounted LIQUID LEVEL TRANSMITTER

Exclusive static pressure connection for closed vessels above or below atmosphere . . . eliminates need for second instrument.

This sensing diaphragm capsule flange-mounts directly on side of tank. All wetted parts of Type 316 stainless steel, with optional plastic coating for further corrosion protection.

with DIRECT 3-15 psi air output signal

IDEAL FOR: Viscous or corrosive fluids, slurries, and solids-in-suspension, as well as "easy-to-measure" fluids.

Now you can measure the level of "difficult" or easy-to-measure fluids — economically, without the complication of floats or bubble tubes, and with *sustained high accuracy over the entire range span.*

Flange-mounted directly to the side of an open or closed tank, the Type 13FA Transmitter eliminates piping and purging. Its stainless steel diaphragm capsule senses level changes instantly. Conventional tubing leads its output air signal directly to standard 3-15 psi receiver-recorders and controllers without need for intermediate signal converters.

The 13FA provides an accurate, trouble-free solution for level measurement problems. Write for detailed information, or ask your nearby Foxboro Field Engineer to explain its application to your specific process. **The Foxboro Company, 3611 Neponset Ave., Foxboro, Mass., U.S.A.**

FOXBORO

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LIQUID LEVEL TRANSMITTERS

Ion Exchange Equipment

Ion exchangers are solids which can take a "charge" of cations or anions from one liquid and exchange them for different ions of the same polarity in another liquid. Example: "Permutit Q" Cation Exchanger, a sulfonated polystyrene resin. When operated on the "sodium cycle," this resin picks up calcium, magnesium, iron, manganese or aluminum cations from water containing these materials and gives off sodium cations in exchange. When exhausted, the resin is regenerated with a brine (sodium chloride) solution that supplies new sodium cations.

The Table below lists ions commonly found in water and the ion-exchange systems by which they can be removed.

Softening: Removing calcium and magnesium ions that cause boiler scale, soap curd, etc. Done with a cation exchanger, sodium cycle, which also removes iron, manganese and aluminum ions.

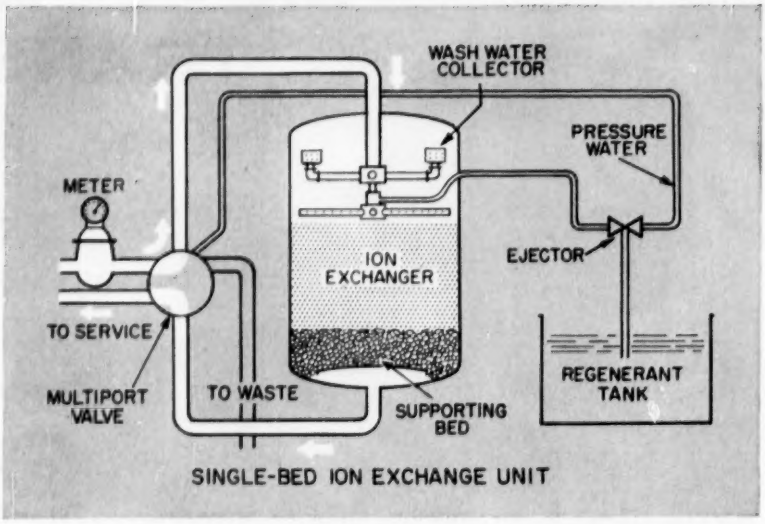
Dealkalizing: Removing bicarbonates and carbonates, generally from boiler feedwater, to reduce corrosion due to CO_2 in condensate returns. Done in 2 steps: cation exchanger, sodium cycle, then strongly basic anion exchanger, chloride cycle.

Demineralizing: Removing cations and anions. Up to nine or ten combinations of exchangers with one to four steps are used depending on the raw water and the degree of purity required for a specific use.

Functions of equipment

Ion exchange equipment is designed to accomplish these basic cycles: The *service run* during which the water flows through the bed of ion exchanger (usually downflow); *backwashing* (upflow) for removing suspended solids filtered out by the ion exchanger; *regenerant introduction* (either upflow or downflow) which restores the capacity of the ion exchanger and *rinsing* which removes the excess regenerant from the bed.

A manual or automatic motor-driven multiport valve replaces a number of individual valves and greatly simplifies regeneration. Rubber-lined multiport valves are used under corrosive conditions.



SINGLE-BED ION EXCHANGE UNIT

Length of service run is usually controlled by the volume of water through an electric-contact water meter or by automatic water-quality testing instruments such as a conductivity meter.

SINGLE-BED UNITS for softening, dealkalizing, demineralizing

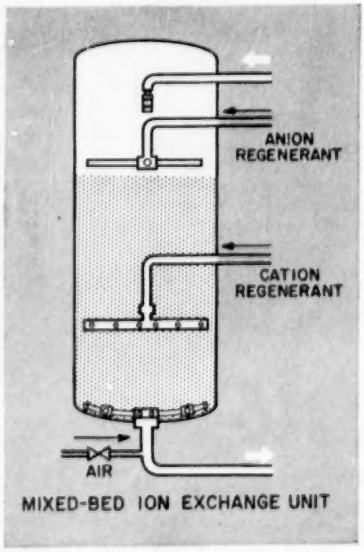
These units contain one type of ion exchanger (cation or weakly basic anion or strongly basic anion). They are similar to pressure filters with ion exchanger in place of the sand and a more efficient distribution and collection system for more uniform flow through the bed.

Two or more single-bed units are required for demineralizing . . . one or more for a cation exchanger and one or more for each type of anion exchanger used.

MIXED-BED UNITS for demineralizing

Mixed-bed units contain both cation and anion exchangers. These are thoroughly mixed prior to the run and provide a multiple-step demineralization.

Backwash rate is closely controlled so that it separates the ion exchanger resins by lifting the lighter anion resin beds over the heavier cation resin. The beds are then regenerated and rinsed while separated, then mixed by air jets from the bottom of the tank and given a final downward rinse before the service run.



MIXED-BED ION EXCHANGE UNIT

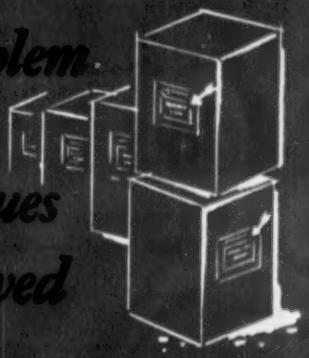
CATIONS	Calcium Ca^{++}, Magnesium Mg^{++}, Iron Fe^{++}, Manganese Mn^{++}, Aluminum Al^{+++}	Exchanged for sodium ions by CATION EXCHANGER regen. with sodium chloride.	Exchanged for hydrogen ions by CATION EXCHANGER regen. with acid.	
	Sodium Na^{+}, Potassium K^{+}			
ANIONS	Chloride Cl^{-}, Sulfate $SO_4^{=}$, Nitrate NO_3^{-}	Taken up as complete acid molecule by WEAKLY BASIC ANION EXCHANGER regen. with soda ash or caustic.	Exchanged for chloride ions by STRONGLY BASIC ANION EXCHANGER regen. with sodium chloride.	Exchanged for hydroxyl ions by STRONGLY BASIC ANION EXCHANGER regen. with caustic.
	Bicarbonate HCO_3^{-}, Carbonate $CO_3^{=}$			
	Silicate $HSiO_3^{-}$			

For information on ion exchange resins and equipment, as well as other water-conditioning equipment, write: The Permutit Company, Dept. CE-11, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

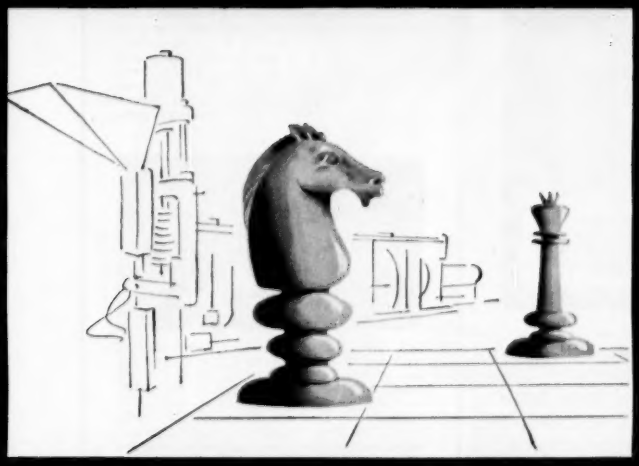
PERMUTIT®
rhymes with "compute it"

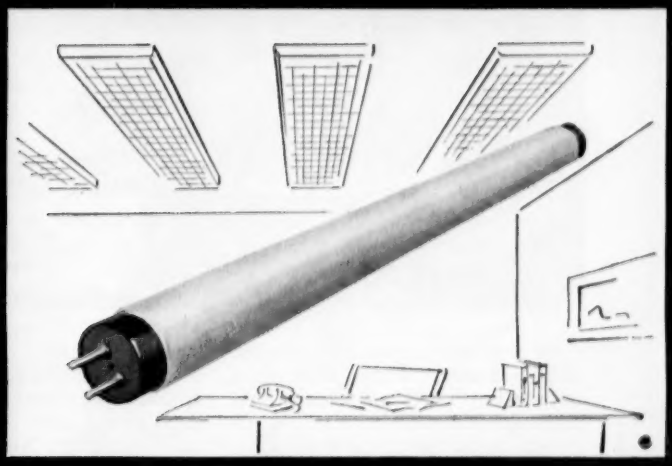
precise PHYSICAL FORM *is a problem*

that Mallinckrodt® *production techniques have often solved*



MALLINCKRODT PROCESS CHEMICALS MEET DIFFICULT SPECIFICATIONS FOR MANY INDUSTRIES





Stearates in Plastics

Mallinckrodt stearates have many uses in industry. *Zinc stearate* is used as an internal and external lubricant in plastics and also as a flatting agent in lacquers. *Magnesium stearate* is an efficient mold-releasing agent for plastic items. *Calcium stearate* is a lubricant and stabilizer in plastics and also improves the plasticity of starch-clay coated papers. Gelling characteristics of *aluminum stearates* are important in manufacturing greases . . . and in paints they increase pigment suspension without making the paints too thick for easy application.

Chemicals for Electronics

The ability of Mallinckrodt research and production chemists to control purity and maintain uniformity of *dibasic calcium phosphate* and other chemicals needed to manufacture phosphors has played an important part in the development of the fluorescent lamp industry. Mallinckrodt *Standard Luminescent chemicals* are also used extensively in producing television phosphors. Mallinckrodt *TransistAR® chemicals* are used in the manufacture of transistors and other semi-conductor devices.

Your particular application of these *and other Mallinckrodt industrial chemicals* may be different. Drop us a note on your requirements —
you might be better served by Mallinckrodt.

Mallinckrodt **MALLINCKRODT CHEMICAL WORKS**

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No Guesswork When Laboratory Crushing or Grinding is Done by Sturtevant Machines

"Open-Door" Design Provides Quick Access for Cleanout — Guarantees Accurate Samples

Sturtevant Automatic Coal Sampler at Con Edison's Laboratory (New York). Sturtevant Bulletin No. 85 describes this machine.

In a matter of seconds, because of hinged access doors, all crushing or grinding parts are exposed for thorough cleanouts — 100% accuracy in sampling.

Design of Sturtevant laboratory machines is based on production models. Higher output — to scale with actual production quality and output, is built into each machine. Add rugged construction and you have a machine that keeps on top of lab or pilot work.

Preferred by laboratories that demand accuracy and dependability in test or pilot runs, Sturtevant laboratory machines have long been used by the 'blue chips' of industry and education. Names on request.

Send for Bulletin 067, which gives full description of all Sturtevant laboratory machines. (Bulletins are also available on Production Crushers, Grinders, Blenders, Air Separators, Micronizers and Automatic Coal Sampler.) Write Sturtevant Mill Company, 100 Clayton St., Boston 22, Mass.

SWING-SLEDGE MILL RETIRES AFTER 25 YEARS . . .

Ruggedness of Sturtevant machinery is well-known in industry, where even laboratory-size Sturtevant units are sometimes used for round-the-clock production.

Jas. F. Morse Co., Boston, recently replaced their small-size Swing-Sledge Mill, which had been doing production grinding for 25 years. It was used to grind ⅝ in. tankage into bone meal. Repairs in 25 years? "Just grates and hammers," reports Plant Manager W. Carleton Merrill.

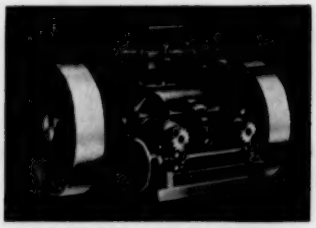
See us at the Chem. Show. Booth 421

STURTEVANT

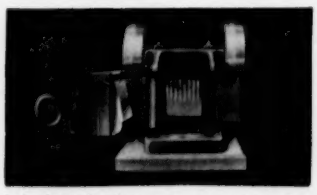
Dry Processing Equipment

The "OPEN-DOOR" to *lower* operating costs over *more* years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

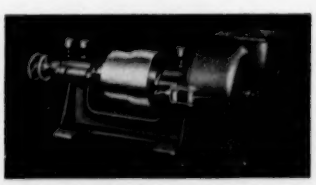


Lab Crushing Rolls: Specially designed for laboratory sampling, Crushing Rolls come in two sizes: 8 x 5 in. and 12 x 12 in. Capacities run as high as 10 tons per hour. Automatic adjustments: 8 x 5 in. model adjusts from ½ in. to 20 mesh; 12 x 12 in. model from ¾ in. to 20 mesh. Tires are high carbon forgings and extra tough. Feeder is automatic, adjustable.



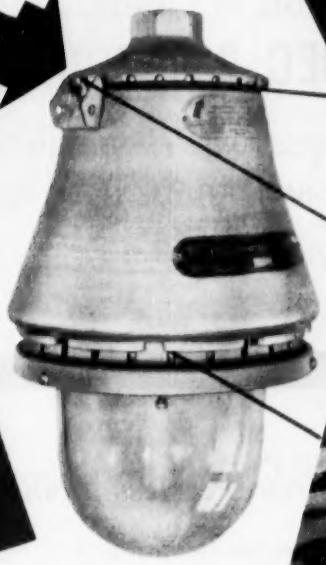
Lab Jaw Crusher: Full or part-time duty for crushing hardest rocks: 2 x 6 in. opening Jaw Crushers have roll jaw action — no clogging. Hard rock capacities: ½ in. setting — 1900 pounds per hour; ¼ in. setting — 1200 pounds per hour; ⅛ in. setting — 800 pounds per hour. Instant in-operation adjustment. Jaw Crushers have manganese steel jaw plates, reversible shields, steel pitman, anti-friction bearings.

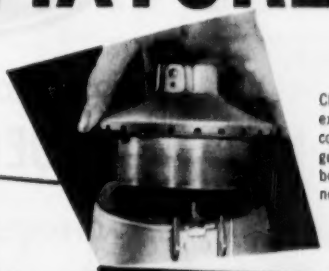
Lab Swing-Sledge Mill: 5 x 6 in. feed opening takes soft, medium, tough or fibrous material. Capacity to 1 ton per hour, fines regulated from 1 in. to 20 mesh. Single-pass limestone grinding produces 99.8% 10 mesh fines, 95.8% 20 mesh. Single-pass bituminous coal pulverizing gives 99.9% 10 mesh fines, 91% 20 mesh. Choice of gratings, hammers (or knives).



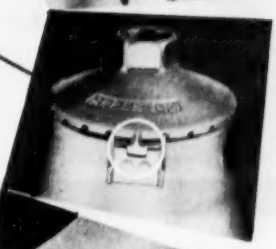
Sample Grinder: Disc type grinders for dry, friable, soft or medium materials. Three sizes — 6 in., 10 in. and 14 in. take feed as coarse as ¼ in. 100 mesh fines at rates to 200 pounds per hour on largest model. Product regulates from 10 to 100 mesh. In-operation adjustment.

APPLETON "AA-51" SERIES VENTED EXPLOSION-PROOF LIGHTING FIXTURES

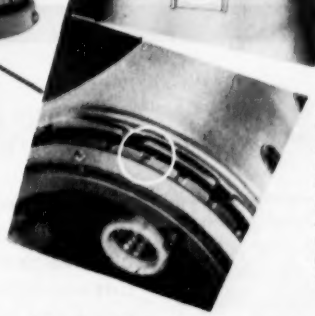




Close-up showing canopy, extra-safe multiple "AA-51" contact threads, and anti-vibration guard with V-shaped metal prong before engaging canopy notches.



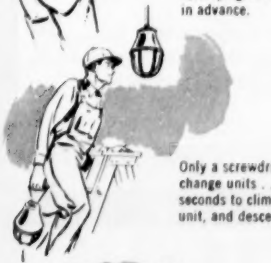
Canopy is securely locked against vibration disturbance by positive engagement of V-shaped metal prong in tightly sealed canopy notch. This anti-vibration guard may be quickly released by hand pressure for maintenance.



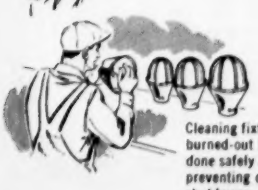
Similar in action to canopy guard, this close-up shows anti-vibration guard locking globe ring to dome unit assembly. Metal prong in dome unit is securely engaged by notched globe ring to prevent accidental loosening. This anti-vibration guard also may be quickly released by hand pressure for maintenance.

58 Second Relamping

Series "AA-51" stand-by units are ready at an instant's notice for relamping . . . with handles attached in advance.



Only a screwdriver is needed to change units . . . and only 58 seconds to climb ladder, change unit, and descend.

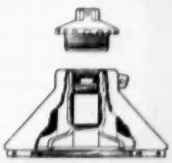


Cleaning fixtures, changing burned-out lamps, can be done safely at bench . . . preventing costly shutdowns.

The fixture with "all" the features now sets even greater standards of efficiency and safety!

APPLETON's new anti-vibration guard on all "AA-51" vented explosion-proof fixtures assures users of positive protection against spark caused mishaps due to vibration conditions. Coupled with multi-thread safety design where a "flame-tight" contact chamber permits servicing *even with the current on*, this new anti-vibration guard demonstrates APPLETON's continuing quality research program to bring you the finest in electrical products. Check these other features for proof of "AA-51" design leadership and adaptability for your requirements. Write for complete information today.

Sold through franchised wholesalers only



"Full Circle Venting"
Porous metal interior and specially designed hood dissipate heat evenly and safely . . . keep fixture temperature down, provide longer lamp life.

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APPLETON ELECTRIC PRODUCTS

Also manufacturers of:

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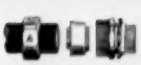

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Malleable Iron Unilets

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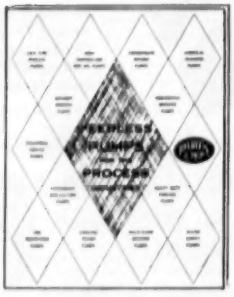
NEW YORK, DEC. 2-6, BOOTH 831

ON DISPLAY: ***New*** CHEMICAL PROCESS PUMPS • ***Modern*** WATER HANDLING PUMPS
With "DO-IT-YOURSELF" SHAFT DEFLECTION TEST EQUIPMENT

Constructive • Interesting • Informative

For the Chemical Industries, Peerless products include:



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REFINERY PROCESS PUMPS
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Write for condensed PROCESS PUMP BULLETIN *– fully illustrated, with capsule pump characteristics*

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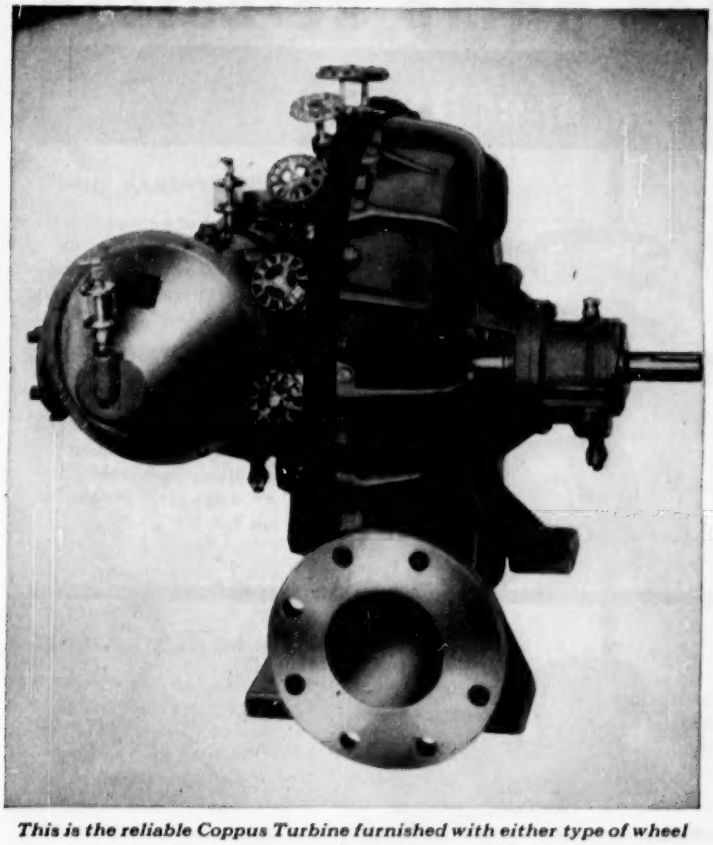
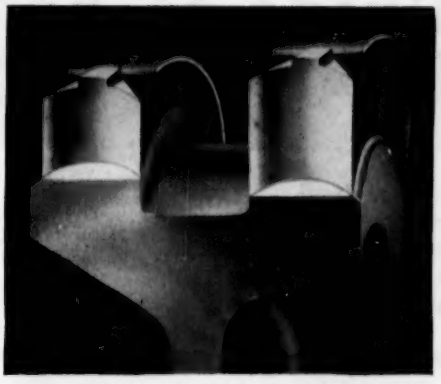
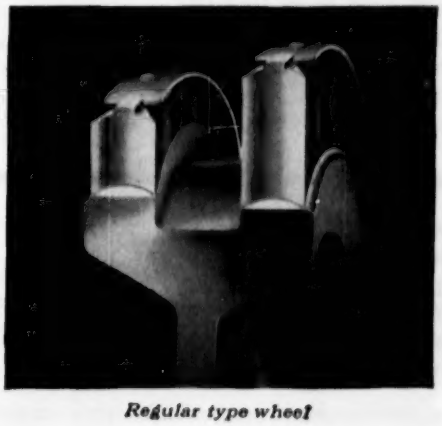


This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel



Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

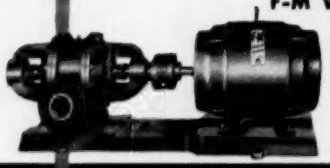
- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
231 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

Guide to better pump selection

for		specify
boiler feed condensate return hot and cold liquids chemicals refrigerants, etc.	up to 200 gpm. pressures to 900 ft.	 **F-M WESTCO PERIPHERAL PUMPS** High pressure at normal operating speeds. Handle widely varying heads with little change in capacity. Sizes 1¼" through 2½".
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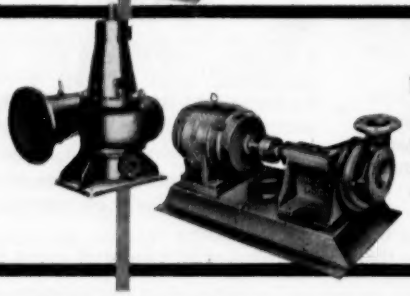
sewage slurries paper stock fruit shrimp vegetables, etc.	up to 30,000 gpm. pressures to 175 ft.	**F-M NON-CLOG PUMPS** Unexcelled for clog-free handling of liquids with solids in suspension. Sizes 2" through 20". Vertical or horizontal. Bladeless or conventional.
water supply plant service booster circulating air conditioning refrigeration chemical liquids boiler feeds, etc.	up to 50,000 gpm. pressures to 700 ft.	**F-M SPLIT-CASE CENTRIFUGAL PUMPS** High, sustained efficiency over wide range of conditions. Low-cost maintenance. Sizes 1½" through 36". Single stage or multistage.
hot and cold liquids chemicals circulating liquids nonviscous liquids cooling towers condenser circulation, etc.	up to 100,000 gpm. pressures to 250 ft.	 **F-M END-SUCTION PUMPS** A wide line of rugged, precision-built pumps. Sizes ¾" through 54". Horizontal or vertical centrifugal.

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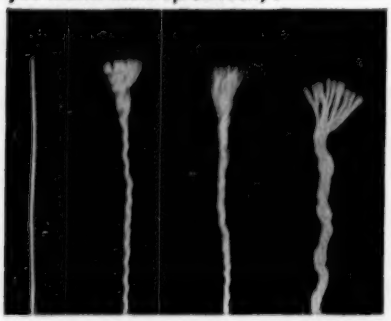
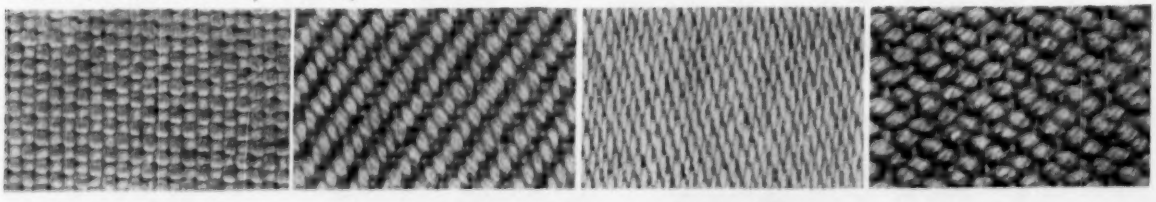
Test your FILTER FABRIC KNOWLEDGE here!

1. Yarns are the basis of fabric construction. Yarns shown here are plied, spun single, monofilament, multifilament. Can you match them up correctly?

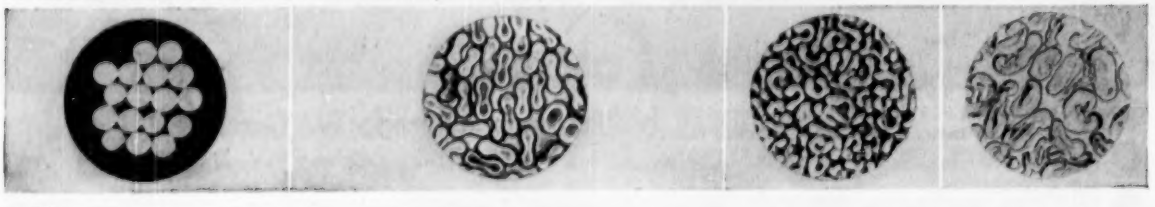


Processing engineers have to know many things, but they don't necessarily have to be filter fabric experts. Not when they can rely on Wellington Sears and the specialists who distribute our filter fabrics. This little test will help you check your knowledge of some basic fabric facts. It will also serve to remind you of the help always available through Wellington Sears. For more information write for "Filter Fabric Facts," Dept. L-11, Wellington Sears Co., 65 Worth St., New York 13.

2. Weaves are just one factor affecting filter fabric performance. Here are three basic weaves, satin, twill, and plain, plus one variation, chain cloth. Can you identify all of them?



3. These are cross-sections of Orlon®, cotton, dynel, and nylon fibers. Which are which?



Turn upside down for answers

3. a. nylon, b. Orlon, c. dynel, d. cotton
2. a. plain, b. twill, c. satin, d. chain
1. a. monofilament, b. multifilament, c. spun single, d. plied

WEST POINT TEXTILES

WEST POINT MANUFACTURING CO.

®DuPont's trade mark for its Acrylic fiber.

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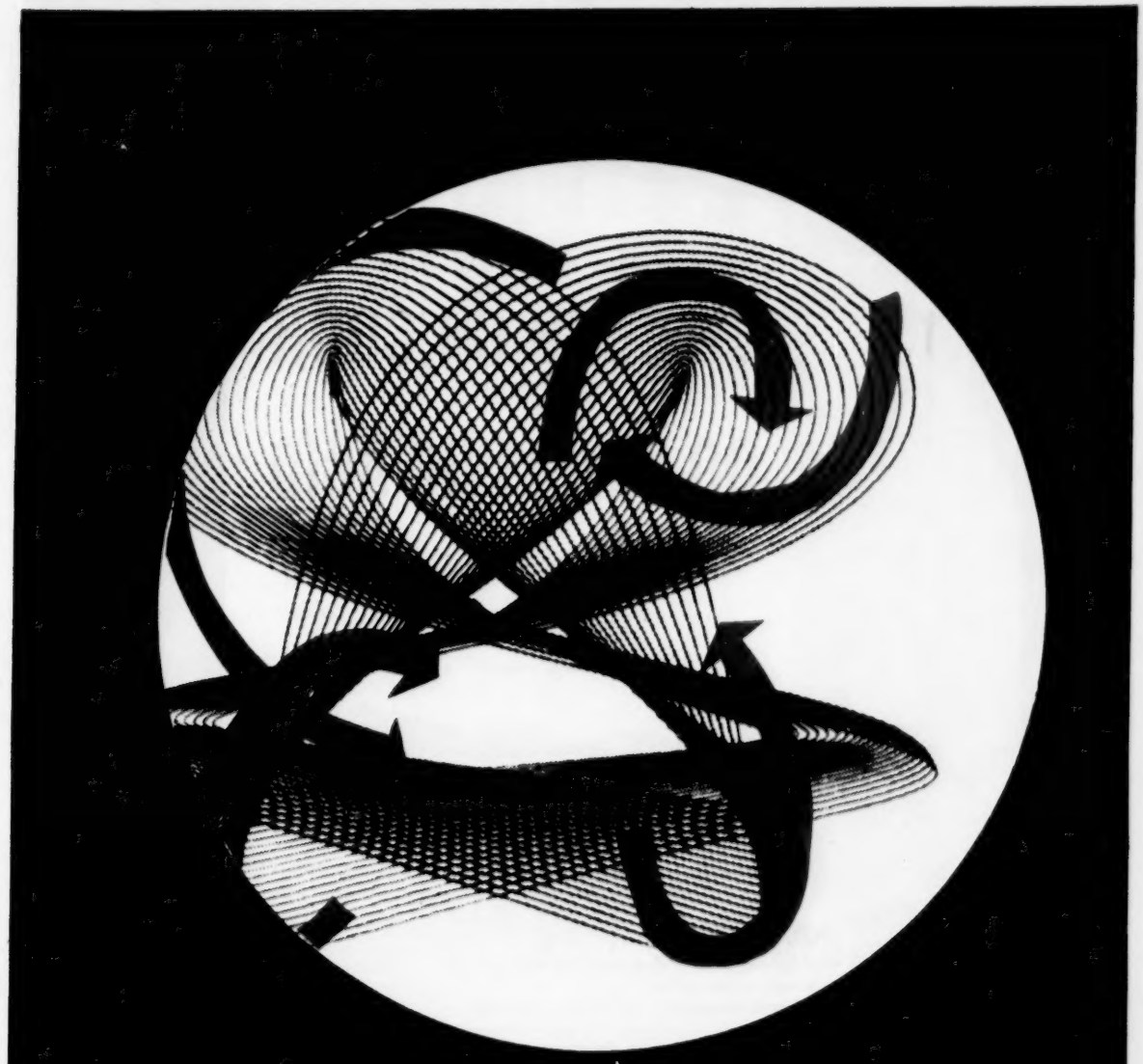

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where complete dispersion is paramount . . .
where consistency, uniformity, quality count . . .
you can count on READCO mixers!

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a division of
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NEW UNUSUAL RAW MATERIAL

$CH_3COCH_2CH_2COOH$

QO LEVULINIC ACID

POLYFUNCTIONAL:

Acts as a carboxylic acid and as a ketone
Has many active hydrogen atoms
Cyclizes to heterocyclic forms

Levulinic acid is a stimulating chemical with which to work because of the unusual variety of its reactions. It reacts as a carboxylic acid, and it functions as a ketone. Notice, too, that the 1,4 stereochemical relationship of its functional group frequently leads to cyclization, forming heterocycles, an open door to new products for you. Condensation reactions of its methylene groups invite further investigation.

Levulinic acid can be converted in good yield to: gamma-valerolactone by hydrogenation; succinic acid by catalytic oxidation; 5-methyl-2-pyrrolidone by reductive amination; calcium levulinate by neutralization; alpha-angelica lactone by dehydration.

QO Levulinic acid is now available from our pilot plant in cans and drums. Drum carload quantities can be supplied. The manufacturing process is suitable for full scale production on a commercial unit.

Write for our new Bulletin 301 on QO Levulinic acid and a sample.

The Quaker Oats Company
CHEMICALS DEPARTMENT

335V The Merchandise Mart, **Chicago 54, Illinois**
Room 535V, 120 Wall Street, **New York 5, New York**
Room 435V, 48 S.E. Hawthorne Blvd., **Portland 14, Oregon**
Room 6155V, 815 Superior Ave., **Cleveland 14, Ohio**

Sam Spinner's Mail Box

by Sam Spinner

Case #1: How can we dry several large bulky items at one time?

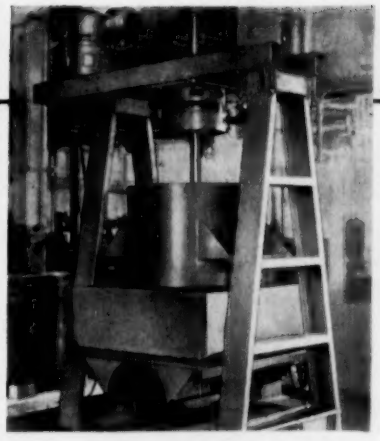
Solution: A T & M Engineers developed a huge Link Type Extractor which would handle loads of several thousand pounds, and also keep power requirements to a minimum.

Case #2: Our Parts Production Line has a bottleneck. Due to the shape of some of our parts, we are unable to handle or unload them in a conventional parts drier. What can you do for us?

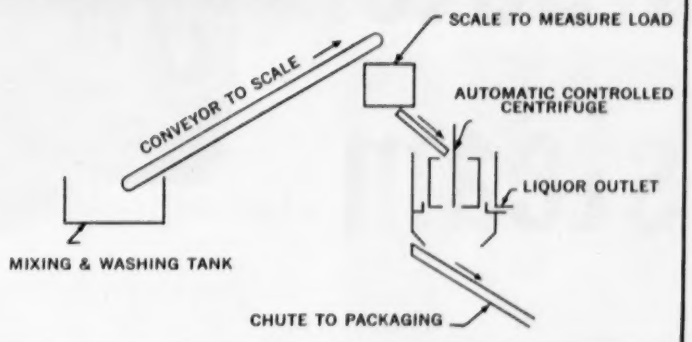
Solution: A Bottom Discharge Machine was developed which not only handles the troublesome parts, but also makes it possible to control entire operation automatically.

Case #3: We have a problem of throwing off excess coating after a hot dip, and are unable to clean unit as easily and fast as we require.

Solution: A special machine was developed to give extra fast acceleration to remove excess coating before solidification. Housing unit was made to open wide to facilitate cleaning in a very short period.



FLOW CHART shows automatic handling of bulk solids in an AT&M centrifugal. Solids are treated more gently than when operators did the material handling.



Solids separated gently ... and automatically

Many "special" chemical processing problems find *the one best answer* in centrifuging engineered by AT & M experts.

Here liquids are to be separated from the solids . . . but the solids must be treated gently. AT & M engineered this machine that handles the products without the use of bags. It carefully loads into the basket through AT & M's slow-speed loading drive. After extraction, the basket is unloaded onto a conveyor by a new type bottom discharge basket without the use of a plow. The whole cycle is performed automatically without need of an attendant.

New AT & M models make maximum use of time and space, with top safety. Send coupon for data.

AMERICAN TOOL & MACHINE COMPANY
1415 Hyde Park Ave., Boston 36, Mass.

Please send me my free copy of the new AT&M booklet "Centrifugal Force." I am interested in the following processes:

Separation ☐ Extraction ☐ Dehydration ☐ Clarification ☐
Coating ☐ Filtration ☐ Draining ☐ Thickening ☐ Impregnation ☐
Sedimentation ☐

SAVE TIME, SPACE AND COSTS WITH

A.T. and M.
CENTRIFUGING

Name.....Title.....
Company.....
Street.....
City.....Zone....State.....

don't waste steam

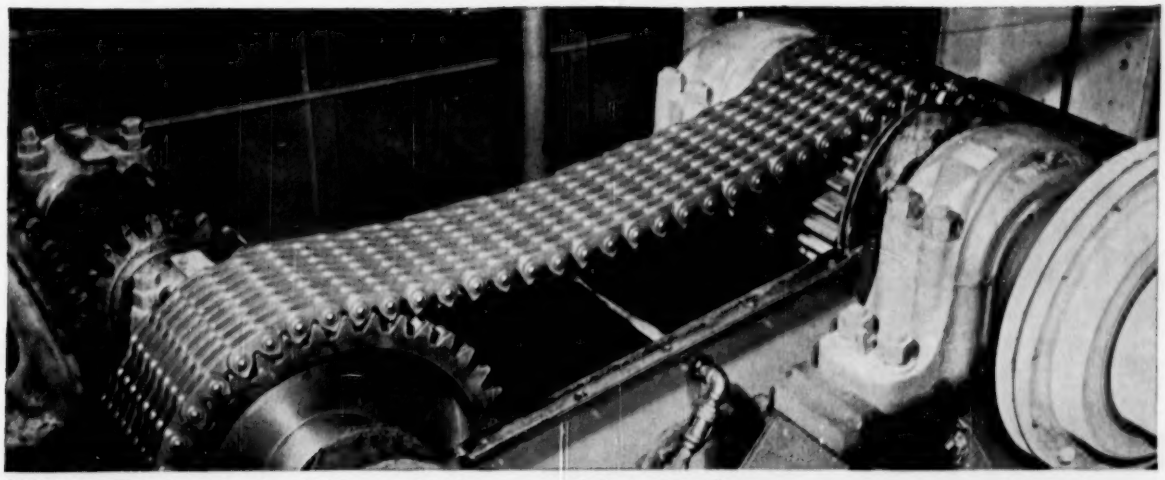
Nicholson steam traps have a powerful, intermittent valve action which closes the valve *completely*. Hardened stainless steel valve and seat are lapped and mated—there's no steam waste, no dribbling. And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

- **high air-venting capacity . . . for faster warmup of equipment.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that avoids waste, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055

NICHOLSON
of Wilkes-Barre



HIGH SPEED. Traveling at speeds as high as 5000 fpm, silent chain drives readily accommodate the extreme peak loads without losing their better-than-98% efficiency.

How LINK-BELT silent chain drives survive industry's roughest requirements

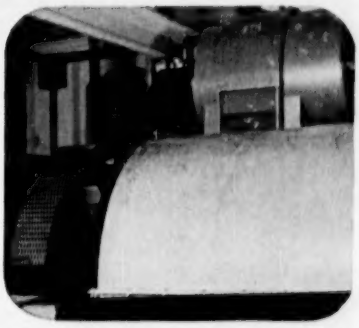
Would your drives do as well?

On applications like these and scores more, no other type of drive is the equal of Link-Belt silent chain. Ask your Link-Belt office or authorized stock-carrying distributor for comprehensive 88-page Book 2425.

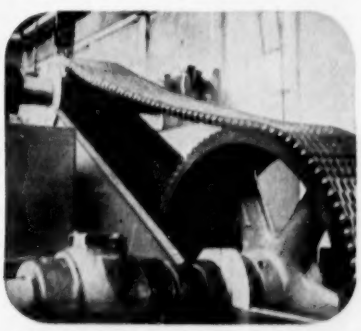
LINK-BELT

SILVERSTREAK SILENT CHAIN DRIVES

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,079

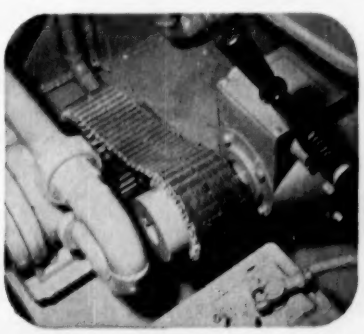


LARGE OR SMALL HP. On a 300 hp drive like this or at fractional hp, silent chain is always lower in ultimate cost.

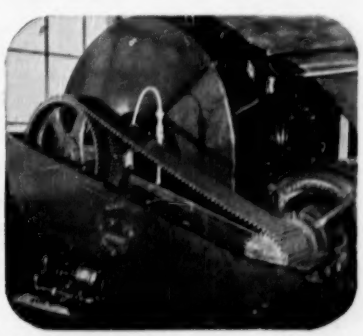


LARGE RATIOS. Link-Belt silent chain operates efficiently on extremely short centers at ratios as high as 10-to-1.

ADVERSE OPERATING CONDITIONS. Heat, humidity and cold have little effect on Link-Belt silent chain drive performance.



LIMITED SPACE. Easy to assemble in close quarters, Link-Belt silent chain permits built-in drives, compact housings.



LONG LIFE. This drive is 16 years old and still going strong. Not unusual—many others have lasted twice that long.

The Superiority of Pritchard Cooling Tower Filling Is a Matter of Record*

*

AND CONFIRMED IN THE FIELD

After all, it's the performance of a cooling tower that counts most in the final analysis. And, the performance of any cooling tower is dependent upon the efficiency of the packing or filling used in the tower.

Results of recent performance studies, which tested all types of cooling tower deck filling known to be in use in counter flow cooling towers, justify Pritchard's statement that, "Pritchard Cooling Tower Fill Is Superior."

The Results of These Tests Are Available to You . . . in an article titled "Comparative Performance of Cooling Tower Packing Arrangement," reprinted from a recent issue of a leading trade journal. We would be pleased to send you a FREE copy of this study. Just a note on your company letterhead will do.

Another FREE Offer! In addition to the paper on "Comparative Performance of Cooling Tower Packing Arrangement," you will most likely want a copy of "ANSWERS TO 15 QUESTIONS ABOUT PRITCHARD INDUCED DRAFT COOLING TOWERS." This fascinating brochure will be invaluable to you in helping you select the proper cooling tower for your specific needs. This, too, is yours for the asking—no cost, no obligation.

SEND FOR BOTH, TODAY!

INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES
IN PRINCIPAL CITIES
FROM COAST
TO COAST

J.F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. SB14415 Roanoke Parkway, Kansas City 12, Mo.

24-hour-a-day service under the most severe chemical plant conditions

Pressures to 60,000 p.s.i.

Capacities to 31 gal/hr.

Chemical Proportioning Pump

A pump that provides trouble-free service for chemical plants on a 24-hour-a-day schedule. The pump will operate at rated pressures for as long as a year and a half without a major overhaul.

- Piston stroke manually-variable from 0 to 100% while pump is under full load.
- Stroke-varying mechanism does not move while pump is in operation, permitting very accurate volumetric settings while operating.
- Displaces entire contents of the cylinder at each stroke of piston, irrespective of stroke adjustment. Length of stroke is shown on an indicating scale.

- **Both fixed and variable stroke models available.**
- **Piston and cylinder assemblies are interchangeable in housing, making it possible to change capacities and pressure ratings.**
- **Simplex and duplex models available as standard. Triplex and quadruplex models can be supplied on special order.**

Complete information in
Bulletin 4065-C
furnished upon request

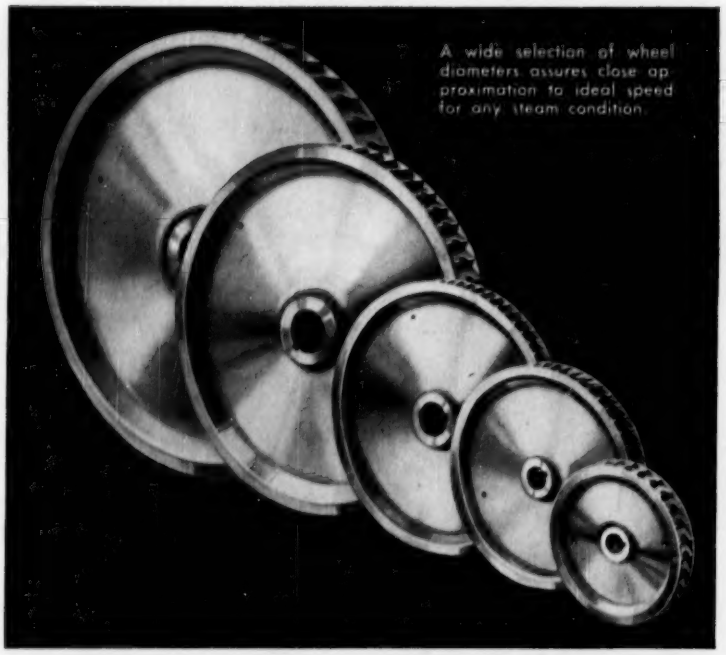
AMINCO

AMERICAN INSTRUMENT CO., INC.
8030 Georgia Ave., Silver Spring, Maryland

In Metropolitan Washington, D.C.

There's a TERRY wheel turbine to meet your specific needs!

SOLID-WHEEL DURABILITY COMES IN ALL SIZES...



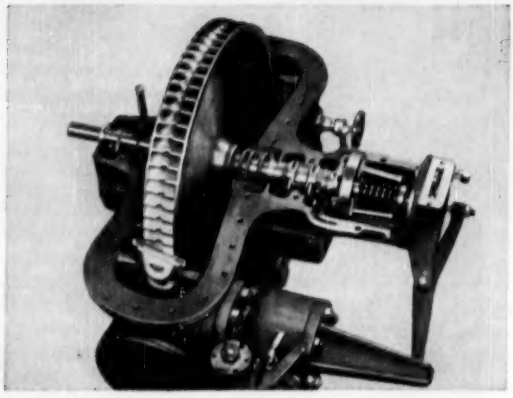
up to 2000 HP

Wherever you need dependable turbine drive up to 2000 HP—and strength and durability are major factors—Terry solid-wheel turbines are specifically equipped for the job. For, within their simple, sturdy casing is a rugged one-piece wheel.

You choose from a broad selection of sizes for all mechanical drive applications—with each Terry wheel turbine accurately proportioned to fit the operating conditions. From the smallest to the largest, these rugged turbines have:

- Solid one-piece wheel.
- Large radial and axial clearances.
- Double rim protected blading.
- Individual nozzle control.
- Dependable and durable governor.
- Heavy dust-proof bearing and governor housing.
- Independent overspeed trip with separate valve.
- Sturdy casing design.
- Strong and easily inspected steam strainer.
- Truly accessible construction, which makes inspection of the interior parts a simple matter.

For full details, send for a copy of bulletin S-116.



Terry wheel turbine with cover removed to show the solid wheel. There are no separate parts to loosen or work out. Blade clearances are generous.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

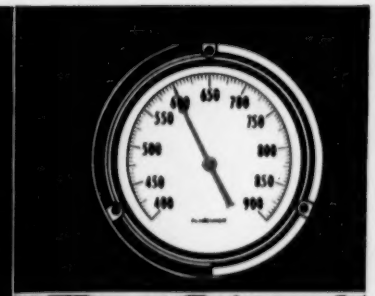
Continuous operating temperature up to 600° F.

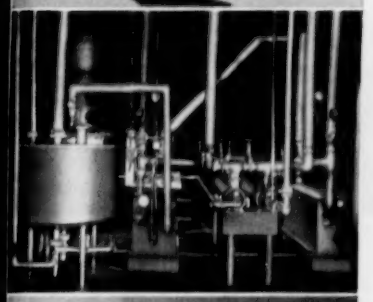
Isn't this the kind of heat transfer system you want?

Pin-point control to within 2° F.

Lower cost, non-pressurized equipment

Safety from fire and explosion





... THEN YOU WANT A

non-pressurized Aroclor 1248 system

Aroclor 1248 is a new kind of heat transfer fluid that's fire-resistant . . . operates at atmospheric pressure.

The Equipment . . . capacities can range from small portable units—usually electrically heated—to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Circuits are closed, forced circulation. Compact design saves space, minimizes installation and maintenance costs.

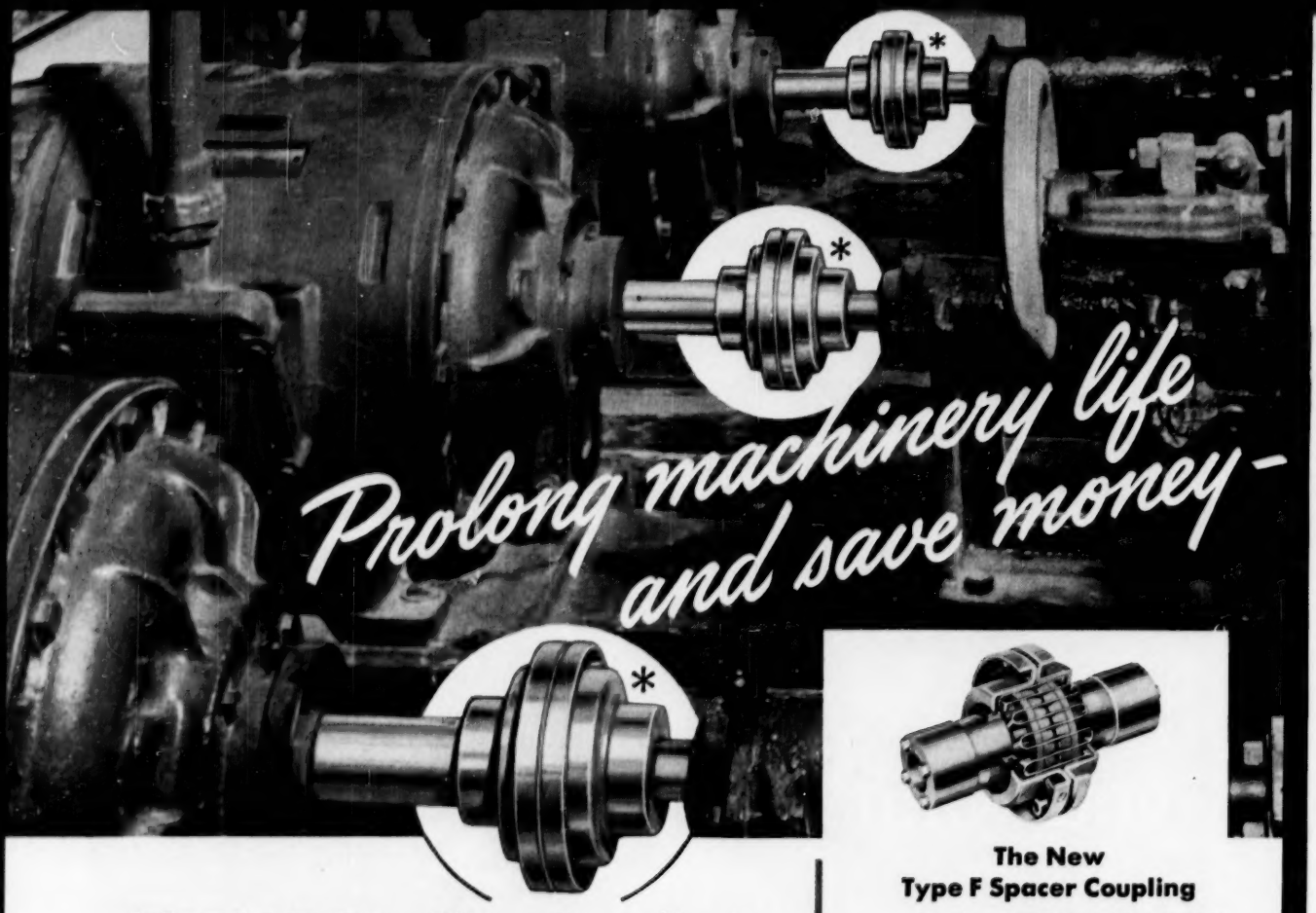
The Fluid . . . Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; has autogenous ignition temperature of extremely high 1299° F.; is noncorrosive; operates in most systems four to seven years without replacement.

Contact Monsanto for sources of Aroclor 1248 heating systems, information about Aroclor 1248 heat transfer fluid.

MONSANTO

Where Creative Chemistry Works Wonders For You

Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. IF-71, St. Louis 1, Missouri



Prolong machinery life and save money—

with FALK Steelflex Couplings

Ever since the first Falk Steelflex Coupling was designed and built, we have firmly held to these beliefs:

1. A coupling, to give fullest value, must do more than merely *connect* driving and driven machinery—it must *protect* the machinery and prolong its life.

2. A coupling, to be truly flexible, must overcome the effects of shock and vibration, as well as shaft misalignment.

Proof of the soundness of those beliefs is furnished by the record. More than one million Falk Steelflex Couplings have been used on every conceivable type of industrial application . . . giving trouble-free service, providing maximum protection to connected machinery.

* A single basic type—the famous Type F—fills 90% of all industrial application needs. It is versatile, efficient and economical. And—it is always available from factory, field or distributor stocks, in a wide range of sizes.

Write to Department 247 for engineering bulletin, including selection and dimension tables.

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

FALK

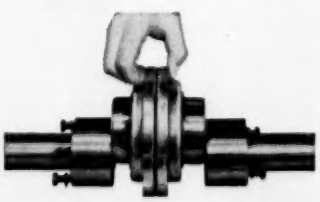
...a good name in industry

The New Type F Spacer Coupling

Here is a Steelflex coupling specially designed to permit fast, easy installation and removal in horizontal and vertical applications where it is impracticable to move the connected units—or where a space-gap (up to 12 in.) is necessary.

Like all Steelflex couplings, the Type F Spacer gives long, trouble-free service and maximum 3-way protection for connected machinery: it provides torsional resilience to reduce shock and vibration; it accommodates parallel or angular shaft misalignment; it allows free (or limited) end float.

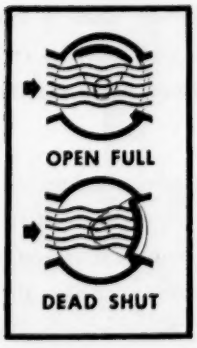
An outstanding feature of the Steelflex Spacer is that it can be installed or removed in one piece (see photo below); no dismantling or servicing of the coupling is required. Pump assemblies can be disconnected and removed without disassembling the coupling, without exposing working parts.



The Steelflex Spacer coupling is prelubricated at the Factory and can be installed, or removed and reinstalled, without disturbing the lubricant—a highly desirable feature.

WHY RISK *Contamination* FROM *Lubrication?*

DeZurik Plug Valves eliminate the danger of contamination from valve lubricants. They operate easily, without lubrication—without "freezing"—with a quarter turn of the lever. No greases to stock, no fittings to buy, no gauges and guns to maintain. DeZurik Easy-Operating Non-Lubricating Plug Valves are complete in themselves.



ECCENTRIC ACTION

DeZurik Valves operate on an exclusive principle. The resilient-faced plug is pivoted eccentrically in the valve body and contacts the seat ONLY IN THE CLOSED POSITION! As the valve is closed, the plug is swung across and against the seat with a cushioned closure that seals tight despite solids in the flow. In opening the valve, the plug is backed away and to the side in an e-a-s-y quarter turn. No need to jack the plug loose with lubricants, no risk of contaminating the flow!

DRY SOLIDS

Because lubricants are not present in DeZurik Valves, granular material may be handled without special problems.

LIQUIDS

From the thinnest solutions to the thickest slurries, DeZurik Valves handle liquids without leakage, with a minimum of maintenance.

GASES

Lines handling gases under pressure present no problems for DeZurik Valves. The same dead-tight closure is obtainable.

For highly corrosive services, a full range of valve materials and special plug facings are available. See us in Booth No. 907 at the New York Show, or write for details.

DeZURIK CORPORATION
SARTELL, MINNESOTA

DeZurik Corporation
Dept. CE-11
Sartell, Minnesota

Please send me more information regarding DeZurik Valves on (service)

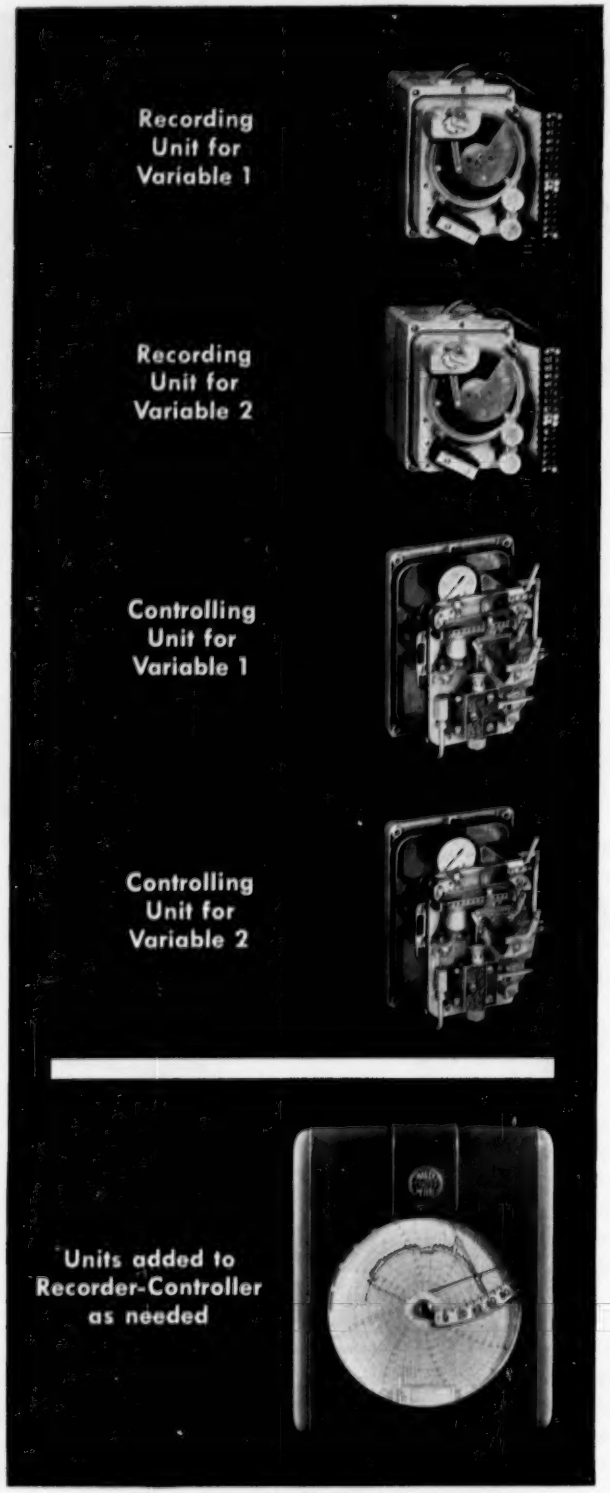
.....

NAME .....

COMPANY .....

ADDRESS .....

CITY..... ZONE..... STATE.....


Recording Unit for Variable 1
Recording Unit for Variable 2
Controlling Unit for Variable 1
Controlling Unit for Variable 2
Units added to Recorder-Controller as needed

Bailey Recorder is key to "step-by-step" automation

When you are pioneering a new process and don't know all the answers, complete automation is seldom practical. The first step is to identify your variables and measure them. Nothing does this job better than a Bailey Recorder. One instrument can record any four variables that can be converted to electric *or* pneumatic signals.

Once you get a better understanding of the variables in your process, you will want to add controls and feed back your measurements. Here's where the versatility of the Bailey Recorder comes into play. For the same Bailey instrument you use to record variables is designed to accommodate plug-in control units.

When you use a Bailey Recorder, you can build your instrumentation along with your process. At the start, you use only the plug-in units for recording. Then you add plug-in controls as you see the need for them.

For the complete story of how you can use a Bailey Recorder for step-by-step automation, see your Bailey Engineer. G-42-1

Instruments and controls for power and process

BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

WHEN MOVING LIQUIDS • • •

CONSIDER—
the Fluid, the Job and the COST!

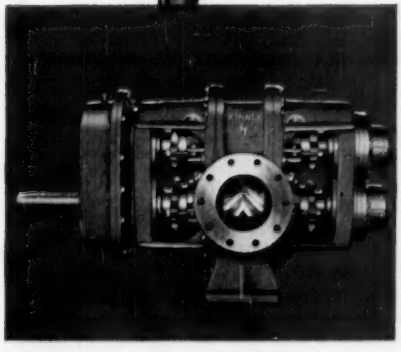
Rotary Pumps are too frequently overlooked because a "just as good" Pump with a low price tag is called upon to perform a function it is poorly equipped to do. It performs after a fashion . . . but at what penalties in time and money?

Kinney®

HELIQUAD PUMPS

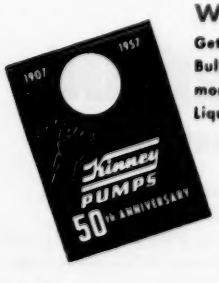
occupy a unique, but *important* place in *your* pumping picture. There are certain jobs that *only* a Rotary Pump can do well and economically. With highly *viscous materials . . . semi-solids* (that must be heated to pump) . . . liquids containing non-abrasive solids . . . with these jobs nothing can touch KINNEY Heliquad Pumps in dollar-saving dependability!

Take a good look behind your production equipment and then check costs on those Pumps that are out of character. Here's where many a hidden loss can be converted into a handsome saving with KINNEY Heliquad Pumps.



KINNEY HELIQUAD PUMPS

Fixed displacement Pumps which provide non-pulsating flow of materials in viscosities from that of gasoline to blackstrap molasses. They have exceptional vacuum characteristics and are highly efficient in handling liquids containing non-abrasive solids. Available in a selection of rotors to suit the particular pumping problem. Plain and steam-jacketed models, flow ranges 6.63 to 2100 gpm.



WRITE:

Get your copy of KINNEY Bulletin No. L51A that sheds money-saving light on the Liquid Handling picture.

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY

3551L WASHINGTON STREET • BOSTON 30 • MASS.

Please send me copy of Bulletin No. L51A giving data on pumping difficult materials and full particulars on KINNEY Pumps.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

MICROAMMETER-MILLIVOLTMETER RECORDER PERFORMS 6 FUNCTIONS

1. Measures low-level dc signals with calibration accuracy within 0.5%, and sensitivity within 0.2% of span.
2. Records on 3" continuous strip chart or IBM-type card chart, with linear coordinates.
3. Positions recording pen with force many thousand times greater than usual direct-deflection electrical movements.
4. Operates on force-balance principle—compensates for ambient conditions, changes in power supply and components.
5. Records fast—up to 0.05 seconds for 63% of fullscale changes.
6. Provides span and zero adjustments for easy calibration and zero suppression in the field, without special equipment.

Here's How To Get

POSITIVE, ACCURATE

Records of Electrical Measurements

ALL THE TIME...

This highly sensitive 'American-Microsen' Series 130 Recorder, with all its operational advantages, costs less than others designed for the same jobs. Simple design, precision components and rugged construction assure sustained high accuracy and freedom from maintenance. The recorder withstands shock up to 30 times gravity.

Since its introduction less than a year ago, the Series 130 Recorder has been very successful because it offers a more accurate and durable method of recording dc electrical signals at lower cost. It is being used to record outputs of many different electrical transducers – for measurement of such variables as pH, gas analysis, signal strength and others.

Many laboratories have adapted the Series 130 Recorder to their analytical and scientific instruments to assure accurate, permanent records of results which previously were only indicated. The Recorder can be used with any device which can provide 200 microamperes or more in its output circuit.

Standard 'American-Microsen' Series 130 Recorders are priced at $250.00. All models have ample power to operate alarm contacts which can be supplied at extra cost. *Write for Bulletin MG10.*

SPECIFICATION BRIEFS

POWER SUPPLY: 115 volts, 60 cycles. **POWER REQUIREMENT:** 9 watts.
INPUT RANGES: Voltage – 0-20 millivolts to 0-100 volts dc. **Current** – 0-200 microamperes to 0-100 milliamperes dc. **Input Sensitivity** – 6700 ohms per volts.
ACCURACY: ± 0.5% of span. **SENSITIVITY:** ± 0.2% of span. **REPEATABILITY:** ± 0.25% of span.
EFFECT OF SUPPLY VOLTAGE: Less than 0.5% error 90-130 volts.
EFFECT OF AMBIENT TEMPERATURE: Less than 0.5% error 50° to 100° F., and less than 1% to 130° F.

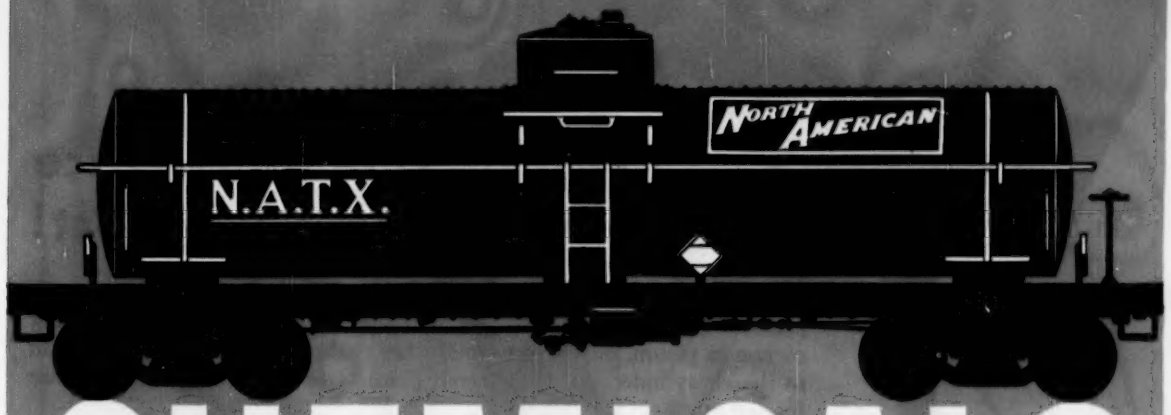
RESPONSE TIME: Fast Speed – 0.2 seconds standard for 63% of fullscale input change; up to 0.05 seconds for 63% on special order. **Slow Speed**– approximately 4 times fast speed setting.
CHART SPEEDS: Strip Chart – 1" per hr., standard; 3" or 6" per hr. available. **Card Chart** – 1 rotation per day, standard.
SPAN ADJUSTMENT: ± 10% of span. **ZERO ADJUSTMENT:** ± 100% of span.
PANEL SPACE REQUIRED: Only 27 square inches.

MANNING, MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION • STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC TRANSMITTERS, INDICATORS, RECORDERS, CONTROLLERS, ELECTRO-PNEUMATIC VALVE POSITIONERS AND ELECTRO-HYDRAULIC CONTROL VALVE OPERATORS.

THIS CAR DELIVERS



CHEMICALS

and customer satisfaction!

Lined especially to requirements, this modern North American chemical car helps you keep customers satisfied. It delivers your product at destination safe, sure, clean and pure as the day of shipment. Special cars lined by you eliminate contact with metal, corrosive action and contamination . . . they help you build repeat business through your superior service to customers. Specify North American—and get *satisfaction!*

NORTH AMERICAN CAR CORPORATION

NORTH WESTERN REFRIGERATOR LINE COMPANY

MATHERS HUMANE STOCK TRANSPORTATION COMPANY

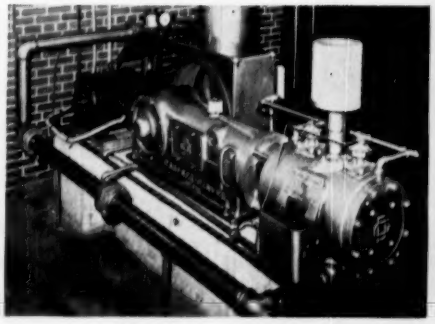
231 South LaSalle Street, Chicago 4, Illinois

A NATIONWIDE ORGANIZATION WITH BRANCH OFFICES IN IMPORTANT MARKET CENTERS

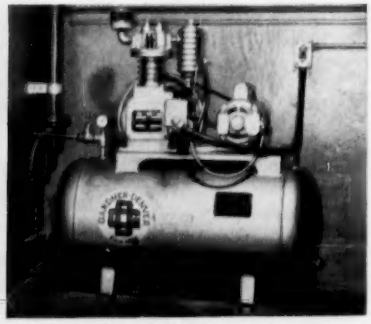
DALLAS • FOND DU LAC • ST. PAUL • ST. LOUIS • TULSA • SAN FRANCISCO • NEW YORK

OIL... fine in its place but not in your product!

End your search for an oil-free air supply. These Gardner-Denver compressors deliver it in abundance, without special filters. Self-lubricating carbon in piston, piston rings and other parts eliminates the need for oil in the air cylinder. Air is delivered clean—free from oil vapor and other foreign matter.



Gardner-Denver CRX carbon piston compressor. Delivers low-cost, oil-free air around the clock. There is no need for two separate air systems; the CRX meets air demands with minimum maintenance. Sizes from 89 to 1292 c.f.m.



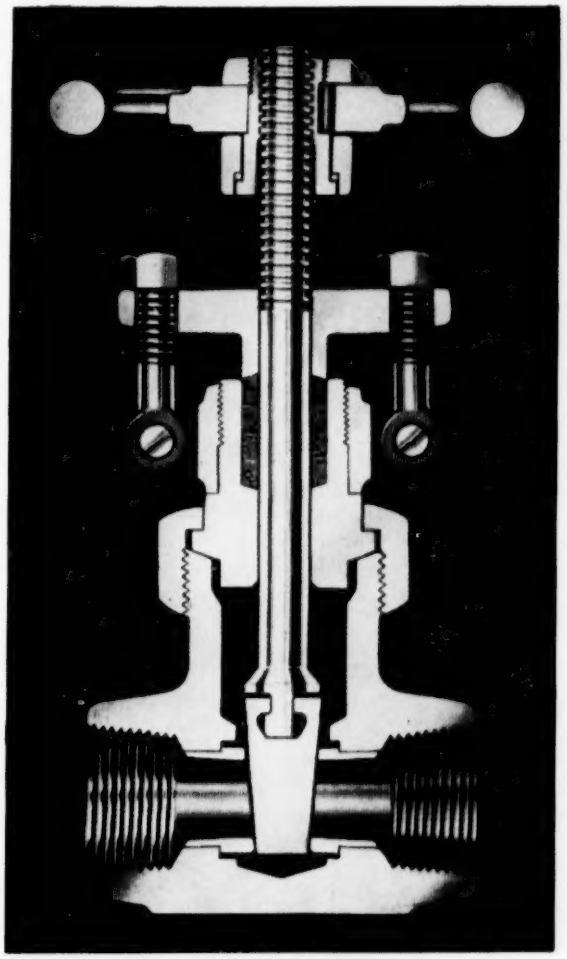
New Gardner-Denver CACB tank-mounted outfit. A small, space-saving, oil-free air producer. Supplies 4 to 5 cubic feet of air per minute. Suitable for discharge pressures of 40 to 100 p.s.i.

Send for bulletins.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario



The Feeling is **MUTUAL**

CHAPMAN LIST 960
Forged Steel Gate Valves

You want small steel valves that give the best performance and cost the least for maintenance. Chapman thinks the same way and does everything possible to give you what you want.

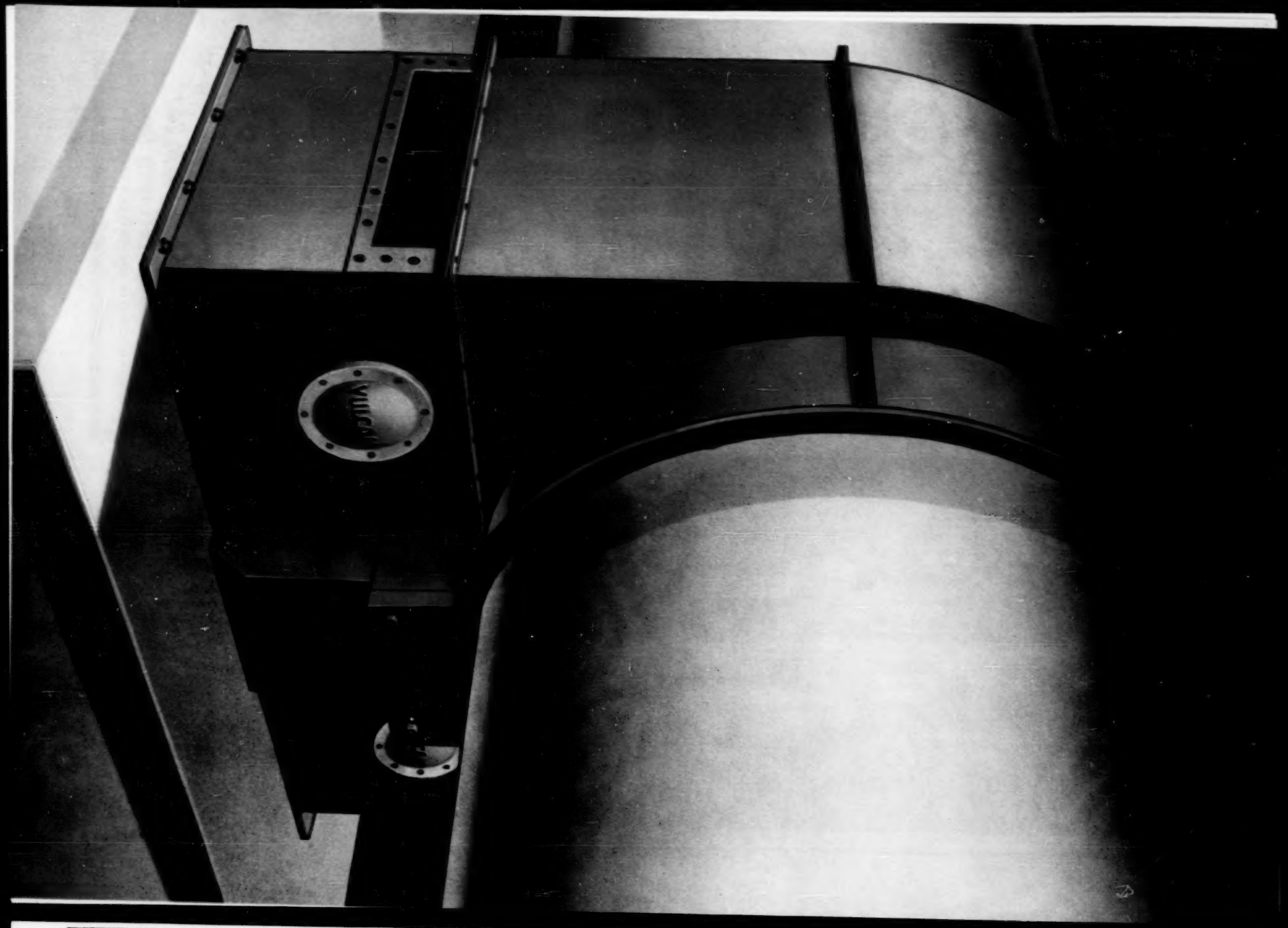
On Chapman List 960 Forged Steel Gate Valves the wedge faces are *super* hard. They're hardened to 800 Brinell by Chapman's exclusive Malcomizing process. They can't seize. They can't gall. They're built for rugged service.

Even the long lasting seat rings are hardened stainless steel and are very easy to replace when necessary. Also, you have no full-pressure repacking difficulties with Chapman List 960 valves.

Today, there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve. Valve men and Chapman see eye to eye on performance and costs. List 960's come in sizes from ¼" to 2". They stand up perfectly under conditions from 380 psi at 1000°F. to 2000 psi at 100°F. Of course, for higher pressures you use Chapman List 990 valves.

With the 960's you can order Bonnet joint either gasketed or ground metal-to-metal. You can have rising stem with yoke or rising stem with inside screw. You find them all in our Catalog 10. Write today for a copy.

The CHAPMAN
Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS



BEFORE THE TURN OF THE CENTURY **VULCAN IRON WORKS** AT WILKES-BARRE WAS DESIGNING AND BUILDING ROTARY KILNS, AND HAS CONTINUED ACTIVE IN THIS FIELD THROUGHOUT THE PASSING YEARS.

AS A FITTING CULMINATION OF THIS LONG PERIOD OF PRACTICAL PROVEN EXPERIENCE, **VULCAN** NOW OFFERS

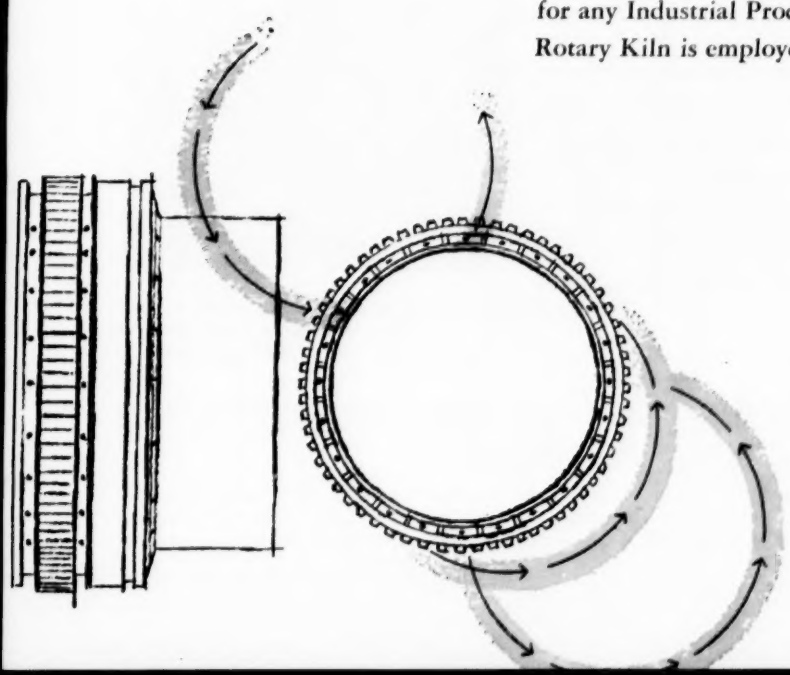
AN UTTERLY NEW CONCEPT IN ROTARY KILN DESIGN

That Will . . .

Simplify Your Foundation Plan . . .
Avoid Frictional Wear . . .
Reduce Torque and Power Load . . .
Save Maintenance Costs . . .
Occasion Less Down Time . . .

And Give You . . .

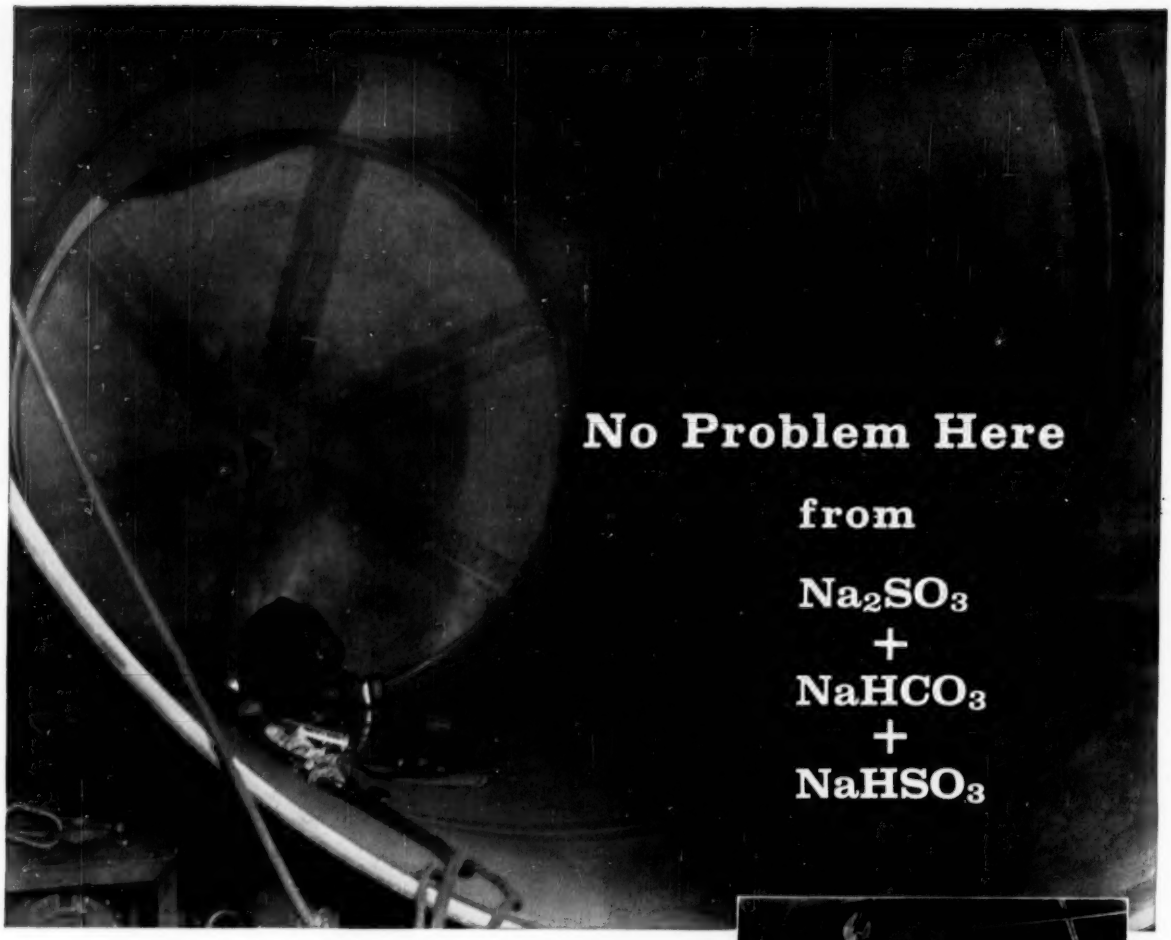
A Trouble-Free Mechanical Unit for inclusion in any plan of Automation for any Industrial Process in which a Rotary Kiln is employed.



You will be interested in seeing how these many advantages have been engineered into this new concept.

May we send one of our engineers to show you how simply this has been done.

VULCAN IRON WORKS
"The Oldest Name In Rotary Kilns"
WILKES-BARRE, PENNSYLVANIA
PAT. APPLIED FOR



How Finch, Pruyn Avoids Costly Corrosion Problems In Huge 5-Story Digester and Blow Tank for New Neutral Sulphite Process at Glens Falls, N. Y.

The neutral sulphite process at Finch, Pruyn & Co., Inc. requires a corrosive cooking liquor for converting hardwood into pulp to make bright, high-strength and economical printing and converting papers. The corrosion problem posed by this liquor in a giant 3,500 gallon, high-temperature digester and in a triple-charge blow tank was met with a tailored combination of steels, fabricated by Graver. The digester, designed to withstand a pressure of 200 psig, was made of Type 316 ELC 20% stainless clad on ASTM A-212 Grade B firebox quality steel. The blow tank was similarly constructed.

For this design by Chas. T. Main, Inc. of Boston, Graver's many years of experience in forming and welding stainless, stainless clad and other alloys assure long life and trouble-free operation. The Finch, Pruyn installation is another example of processing equipment being skillfully fabricated by Graver to combat destructive and costly corrosion.

The 93,400-lb digester, shop fabricated under Graver's exacting standards of craftsmanship, is 11½′ in diameter and 57′ 8⅝″ high overall.

ALLOY DIVISION

1857-1957 GRAVER Our 100th Year

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.

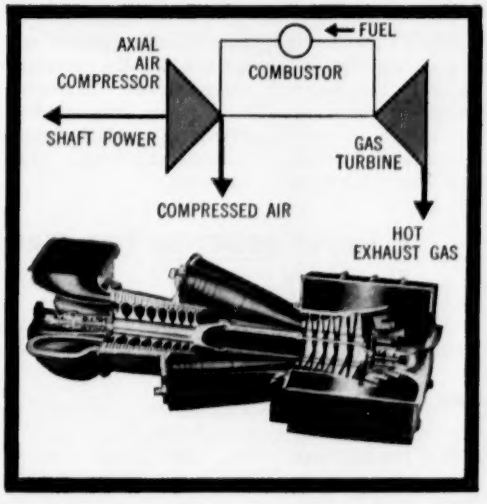
EAST CHICAGO, INDIANA • NEW YORK • PHILADELPHIA • EDGE MOOR, DELAWARE
PITTSBURGH • DETROIT • CHICAGO • TULSA • SAND SPRINGS, OKLAHOMA
HOUSTON • NEW ORLEANS • LOS ANGELES • SAN FRANCISCO • FONTANA, CALIFORNIA

3 FROM 1

Shaft power, compressed air, heat... all from one gas turbine...

BY TAKING ADVANTAGE of the versatile Westinghouse gas turbine, engineers are simplifying many processes. For example . . .

As gasifiers—In a large Southwestern butadiene plant, four Westinghouse gas turbines will soon be operating as gasifiers for the reactivation of the catalyst and each will eliminate the need for a separate prime mover and a separate air compressor.



In addition, smaller line heaters and less fuel will be used because *all* the *Btu's* put into the gas turbine are exhausted to the heaters and process, with the exception of minor radiation and bearing losses.

Versatility—The modern Westinghouse gas turbine can be used to streamline processes, for it offers many combinations of output:

Shaft power.....up to 22,500 hp
Compressed air.....up to 85 psia
Hot gas (18% oxygen) .....up to 1000°F

Ask today for your set of suggested process sketches. Contact your Westinghouse representative, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50598

YOU CAN BE SURE...IF IT'S Westinghouse

F. J. Tompkins, Chief Design Engineer (right), Bernard Anik, Mechanical Engineer (left rear), Singmaster & Breyer, N. Y. C. Foreground, Michael De Piano, Cooper Alloy Corp.

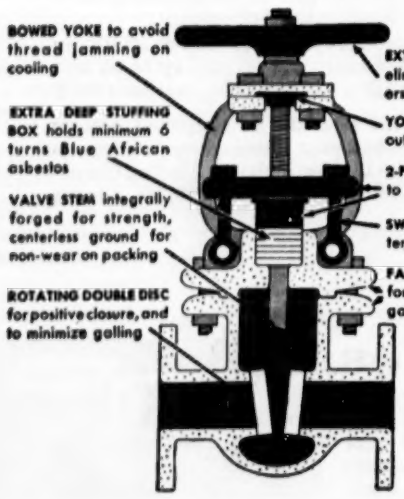
TOMPKINS and ANIK of SINGMASTER & BREYER

tell why they build Cooper Alloy stainless valves into their basic plant designs

Q. Gentlemen, precisely why do you buy Cooper Alloy valves?

FJT—With me, dependability is the main reason. My major concern is overall plant design, and frankly I don't have time to worry about every equipment detail. As specialists in designing and building "first-of-its-kind" processing plants, we need valves we can count on, and can "build in" as part of our original design. Cooper Alloy valves, we've found, fill that bill.

BA—From my point of view as a mechanical engineer, it's the Cooper Alloy valve *design* that appeals to *me*. It has extra features, like the extra-large handwheel, unique square compression of packing, bowed yoke, integrally forged stem, and others, all of which make for less maintenance and longer, more economical valve life.


BOWED YOKE to avoid thread jamming on cooling
EXTRA DEEP STUFFING BOX holds minimum 6 turns Blue African asbestos
VALVE STEM integrally forged for strength, centerless ground for non-wear on packing
ROTATING DOUBLE DISC for positive closure, and to minimize galling
EXTRA LARGE HANDWHEEL to eliminate need for "persuaders"
YOKE NUT REPLACEABLE without valve disassembly
2-PC. GLAND CONSTRUCTION to prevent scoring of stem
SWINGING EYEBOLTS for maintenance convenience
FAIRED BODY-BONNET FLANGES for equal stress and uniform gasket loading

A VALVE DESIGNED FOR STAINLESS!

The Cooper Alloy valve is not an adaptation of earlier brass and iron patterns. Cooper Alloy, with over 35 years of experience in handling stainless steel, created a valve *designed to be cast in stainless!* **Check the Special Design Features shown at left.**

As the little CA man below is saying: *"You can tell a Cooper Alloy Valve as far as you can see it!"* Write today for *your* copy of our folder "Design Factors In Stainless Steel Valves." The Cooper Alloy distributor near you will be glad to show you the complete line of Cooper Alloy valves *and fittings*, and their advantages. He can serve you promptly from local stocks.

COOPER ALLOY

Corporation • Hillside, New Jersey

VALVE & FITTING DIVISION

THIRTY-FIVE YEARS OF STAINLESS STEEL PIONEERING

End Liquid Metering Problems with a Lapp PULSAFEEDER CONTROLLED-VOLUME CHEMICAL PUMP

NO LEAKAGE
NO PRIME LOSS
NO CONTAMINATION
NO STUFFING BOX

● Precise metering, pumping, proportioning and feeding of hard-to-handle chemicals is the specialty of the Lapp PULSAFEEDER. Designed for accurate handling of corrosive and non-corrosive liquids, it is a combination piston-diaphragm pump . . . providing positive displacement with *no stuffing box*. Leakage or contamination of the liquid being pumped is prevented by a hydraulically balanced diaphragm isolating the liquid from the pump's drive mechanism. All pump parts contacting liquid are of special corrosion-resistant materials. Pumping speed is constant; variable flow results from variation in piston-stroke length, controlled manually by hand-wheel, or, in auto-pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

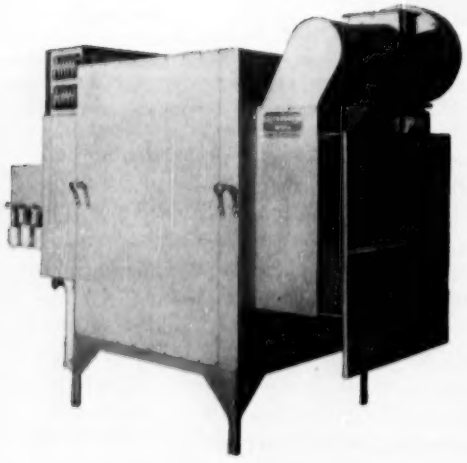
WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 576 Poplar Street, Le Roy, N. Y.*

Lapp

What do you mean

hot and humid?

Temperature 38°, humidity 98%—mid-winter, but just about as nasty and uncomfortable a day as you could imagine. The high humidity made it so.



It doesn't have to be hot to be humid!

Like people, many a process suffers from too much moisture in the air, even when that air is *cold*. Out of doors, fog forms to warn you of its presence. Indoors, unfortunately, high humidities are not so apparent, and we're not aware of moisture in the air surrounding us.

If moisture were pink, we'd be living in a world of color—you'd see this danger signal and take steps to remove the water from the air. Without this warning, processors must be continually on the alert, measuring humidity and controlling it.

Lectrodryer* offers a solution

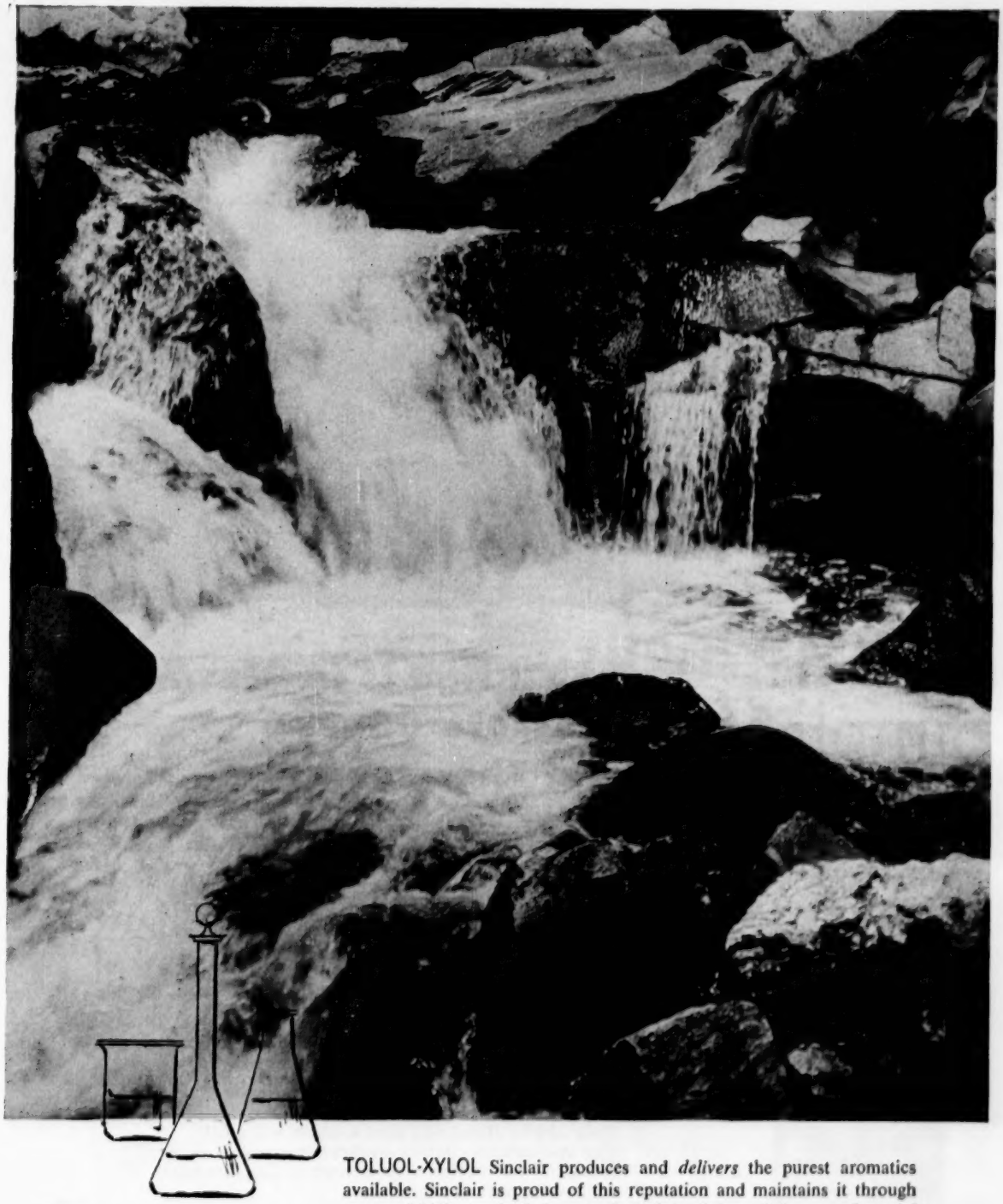
Our engineers will advise on ways of insulating workrooms against moisture infiltration. They'll help you select dehumidification equipment and controls. The booklet, *Because Moisture Isn't Pink*, tells how Lectrodryers are doing this DRYing job for many industries.

For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd Street, Pittsburgh 30, Pennsylvania.

Air-Drying

Lectrodryer

*REGISTERED TRADEMARK U. S. PAT. OFF



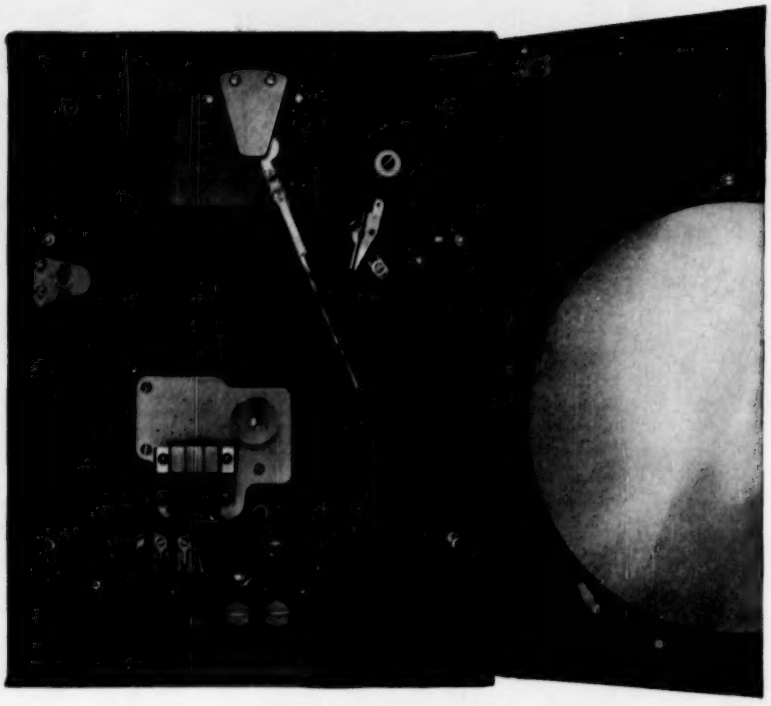
Purity

TOLUOL-XYLOL Sinclair produces and *delivers* the purest aromatics available. Sinclair is proud of this reputation and maintains it through care and high standards in manufacturing – insures it by use of special transportation equipment provided exclusively for aromatics.

If you use solvents in your formulations – get the highest in purity and uniformity. It costs no more. For complete information, call or write:

SINCLAIR CHEMICALS, INC.
(Affiliate of Sinclair Refining Company)

600 Fifth Avenue, New York 20, N. Y. Phone Circle 6-3600
155 North Wacker Drive, Chicago 6, Ill. Phone Financial 6-5900



Simplicity... you'll find it in Brown Pressure Gages and Thermometers

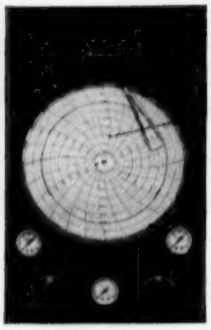
Clean, simple design—simplicity that minimizes operating or maintenance difficulties—sets Brown Pressure Gages and Thermometers apart. These rugged instruments use direct, simple linkages . . . very few parts. Basic components for both thermometers and pressure gages are interchangeable, and cases are identical.

The many narrow spans available, together with the large charts and scales, give you full use of the high accuracy of these instruments.

Brown Pressure Gages are available in many ranges, with a minimum of absolute zero and a maximum of 4,000 psi. Brown Thermometers are particularly suitable for the intermediate temperature range, extending from −125 to 1000 F.

Your nearby Honeywell sales engineer will gladly give you complete details on these instruments as they relate to your particular requirements. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.



Simplicity . . . Versatility, Too

A wide variety of models, ranges and accessories are available for exact matching of Brown Pressure Gages and Thermometers to your specific applications.

Honeywell

H HONEYWELL

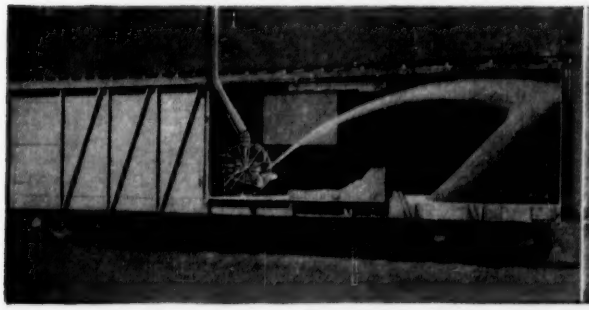
First in Controls

S-A Standard SWIVELOADER
Request Catalog No. 854

CENTRIFUGAL ACTION

with STEPHENS-ADAMSON THROWER UNITS

- Fill box cars and storage bins fuller, faster
- Load and trim—one operation
- Safely and easily operated by one man
- Will efficiently handle up to 350 TPH of grain, fertilizer, crushed ore, sand, gravel, chemicals, and other bulk materials up to 6" lump size
- Improves working conditions, minimizes dust
- "Hi-Type" loads over three grain doors
- Top-quality that provides for dependable, trouble-free service
- Save time, work and money
- Stocked for immediate delivery



S-A BOX CAR LOADER
Request Catalog No. 948

S-A "Hi-Type" SWIVELOADER
Request Catalog No. 854

S-A STANDARD INDUSTRIAL PRODUCTS

STEPHENS-ADAMSON offers a complete line of "in stock" materials handling products that are ready for immediate shipment from your local distributor. For full information, request Catalog No. 60.

STANDARD PRODUCTS DIVISION
STEPHENS-ADAMSON MFG. CO.
3 Ridgeway Ave. Aurora, Illinois

MAIL THIS HANDY COUPON TODAY!

Gentlemen:
Please send me
☐ Catalog No. 854 ☐ Catalog No. 948
☐ Catalog No. 60
☐ Have Representative Call

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proportional positioning

HEART OF THE PROCESS CONTROL SYSTEM

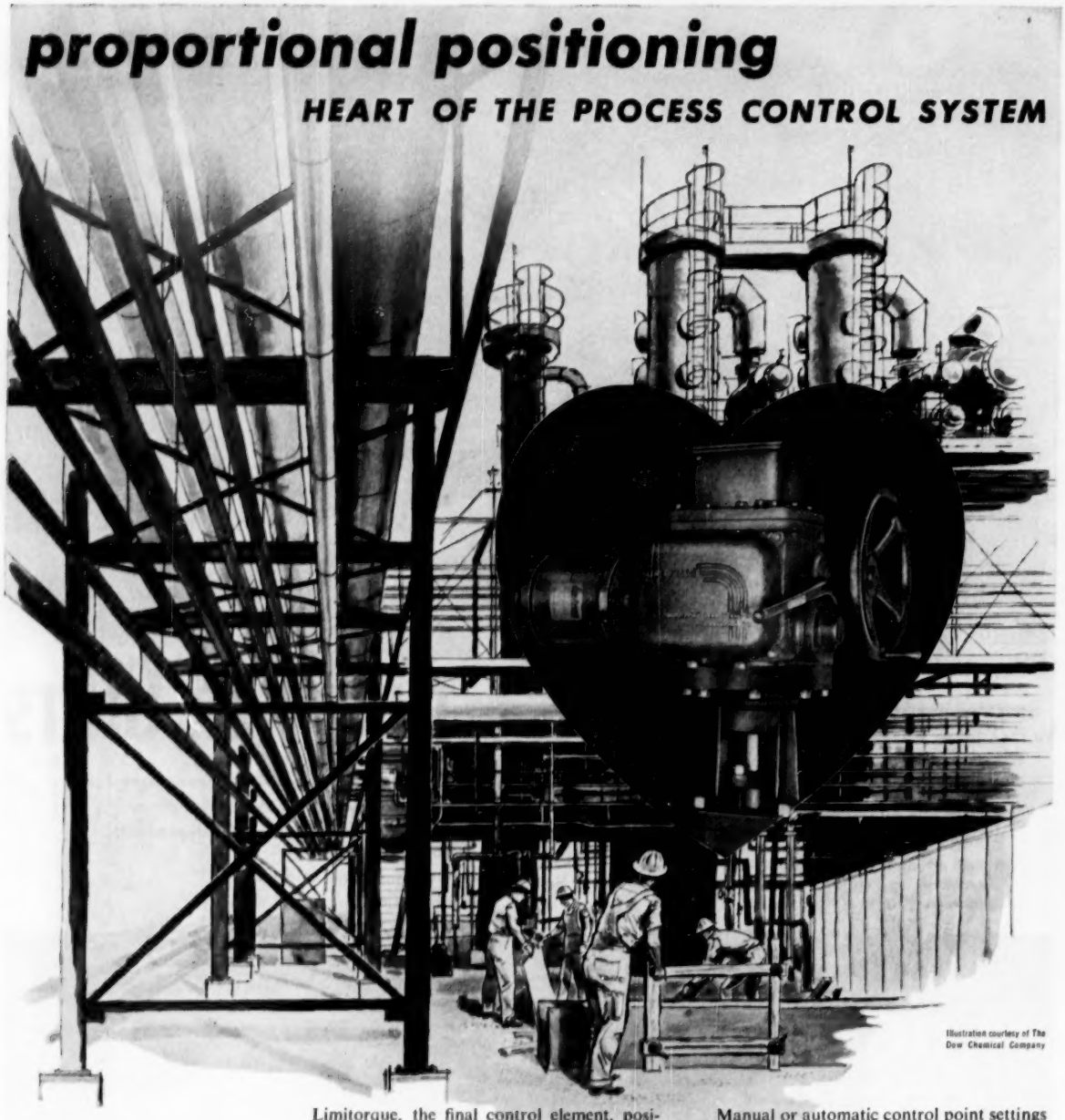


Illustration courtesy of The Dow Chemical Company

LimiTorque converts any variable into a constant...

Limitorque, the final control element, positively converts any up-stream process variable into a down-stream constant by continuously repositioning the control valve.

LimiTorque can be adapted to any control signal given by existing process control equipment and transducers.

Complete control systems are available from LimiTorque, and the components employed in the systems are chosen for dependability, with the elimination of complex circuits and special power supplies, and ease of maintenance.

Manual or automatic control point settings may be made in the control instruments of these systems and thus the required final control position is assured in proportional relationship to variations in the measured conditions.

The demand for centralization of performance responsibility in a single source, for complete process control system, is more than adequately met by these modern all electric actuator systems.

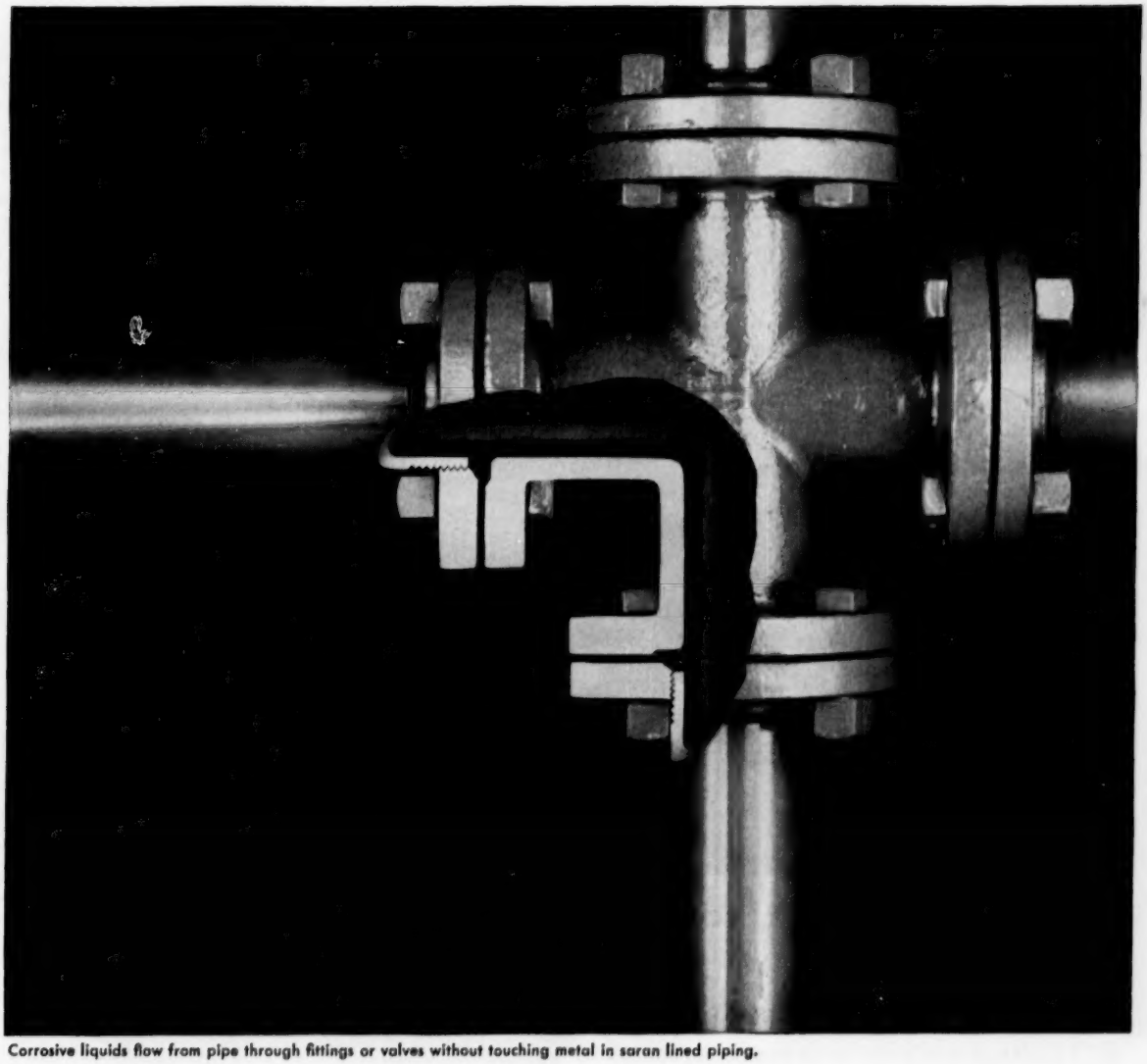
For more detailed information, write for Bulletin #6-57.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia



Corrosive liquids flow from pipe through fittings or valves without touching metal in saran lined piping.

You can see why saran lined pipe stops shutdowns

It's corrosion-resistant saran locked within rigid non-bursting steel

By preventing corrosion, saran lined pipe can stop shutdowns —save labor costs and production loss.

Here is a pipe that resists commonly used acids, alkalies and many other corrosive liquids while having the strength of steel. It can withstand working pressures up to 300 psi. Cast iron and malleable iron fittings and valves are available for pressures up to 150 psi. If you have a high-pressure problem in your operation, cast steel fittings and valves are available for pressures up to 300 psi.

You'll save labor costs, too, in fabrication. Saran lined pipe can be cut and threaded with conventional hand tools.

For tomorrow's protection today investigate saran lined pipe. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY
DEPT. SP1592A-2
2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on saran lined pipe, fittings and valves.

Name_____ Title_____ Company_____

Address_____ City_____ State_____

YOU CAN DEPEND ON DOW

Announces a new member of the already famous family of Ultrascopic Safety Spectacles in a modern 2-Tone Onyx on clear crystal plastic frame

You never had it so

SAFE

AND ATTRACTIVE, TOO!

The true safety of a *safety frame* PLUS smart good looks! American Optical has combined *both* in this latest addition to our Ultrascopic F9500 line.

We cannot overemphasize that *these are true safety frames in every respect* — with all the quality engineering and design features — backed by over 100 years' experience in making optical equipment. By "true safety" we mean that frames, eyewire and lenses are designed and fabricated to give maximum protection. The AO plaque on the frame front is your guarantee that it is a true safety frame.

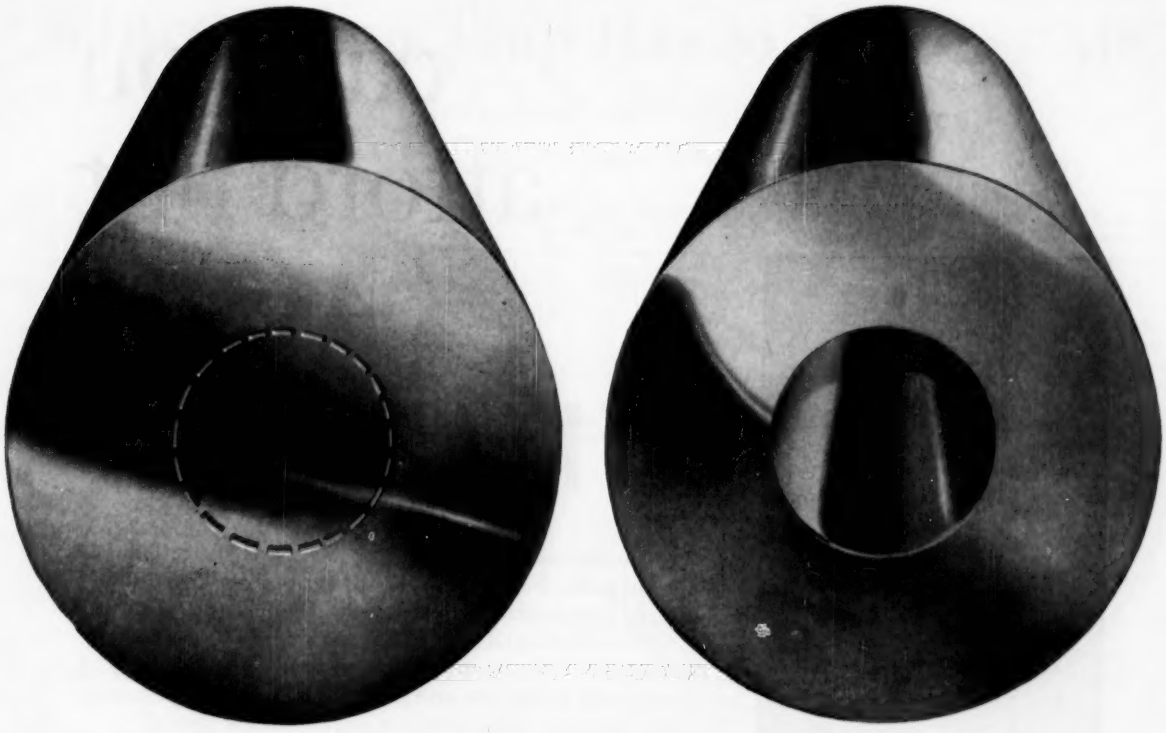
The American Optical 2-tone Ultrascopic has matching spatula temples and is available with 6 Curve Super Armorplate clear, medium Calobar, dark Calobar and extra dark Calobar lenses. It is also available with clear Plastolite lenses.

Give your workers the SAFEST, the SMARTEST, the FINEST. Complete details in our new Brochure No. S-6761. just off the press.

Always insist on the AO Trademark on lenses and frames.

American Optical
COMPANY
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASS. • *Branches in Principal Cities*



WHY BORE OUT BAR STOCK...

use TIMKEN® heavy wall seamless pressure tubing for high temperature applications

IF you've been boring out forgings or bar stock to get the wall thickness you need to withstand higher operating pressures in refineries, steam plants or chemical plants, Timken® seamless steel tubing can save you money. The hole's already there. And you can get the wall thickness you need.

Timken seamless steel tubing is ideally suited to today's higher operating pressures. The piercing process we use gives it a fine forged quality. It also imparts a spiral grain flow for greater strength, a refined grain structure that brings out the best in the metal. And the quality you get is uniform from bar to bar, heat to heat, tube to tube. It's electric furnace fine alloy steel—quality controlled every step of the way.

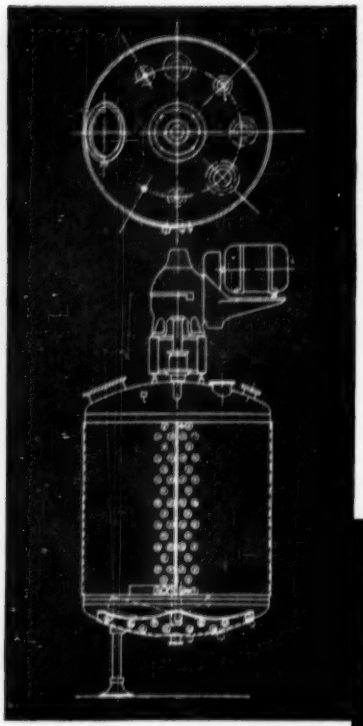
Over 20 years of research and experience makes Timken Company metallurgists the recognized authorities on heavy wall pressure tubing. Ask the experts! Let them help you select—from 22 different analyses and sizes up to 11" O.D.—the size and analysis best suited to your needs. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U.S. PAT. OFF.

See the next Timken Televent hour, "The Innocent Years" over NBC-TV, Thursday night, November 21st.

can you afford not to use TITANIUM?



By themselves, catalog prices of raw materials can be misleading. For it's the final cost—in terms of service life—that really determines what you pay for equipment.

The following table, based on cost analysis by the Pfaudler Company, indicates their estimate of comparative costs of producing the reactor unit shown at the left, using titanium, and two other well-known, corrosion-resistant metals.

	REM-CRU A-55 TITANIUM	METAL A	METAL B
Cost per lb.	$14.60	$0.8025	$2.62
But titanium's light-weight means less is needed . . .			
Material Required	250 lbs.	785 lbs.	675 lbs.
So the comparative cost factor is reduced . . .			
Material Costs	$3650.00	$630.00	$1768.00
Fabrication takes the lions' share, so . . .			
Cost of Finished Reactor	$12,150.00	$2391.00	$4670.00
And in corrosive chlorides, hot acids, and many other environments, laboratory and service data show . . .			
Service Life	5 years	6 months	1 year
NOW . . . COST Per Service Year	**$2430.00**	**$4782.00**	**$4670.00**

Reactor unit of REM-CRU titanium built by the Pfaudler Co., Rochester, N. Y. and Elyria, Ohio a skilled fabricator of titanium and other corrosion-resisting materials.

Don't be fooled by raw material costs alone—*it's the cost per service year that really counts.* Then, too, down-time losses while equipment is being replaced can quickly mount up. Another plus for longer-lasting titanium. Why not let a REM-CRU engineer help you make the best, most profitable use of titanium?

Write Dept. C-11 for the Rem-Cru Review—a free periodical presenting the latest data on titanium.

REM-CRU TITANIUM

World's Most Versatile Metal

MIDLAND, PENNSYLVANIA

Sales Offices: 6033 East Bandini Boulevard, Los Angeles 22, California • 4501 W. Cortland Street, Chicago 39, Illinois • 405 Lexington Avenue, New York 17, N. Y.

Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

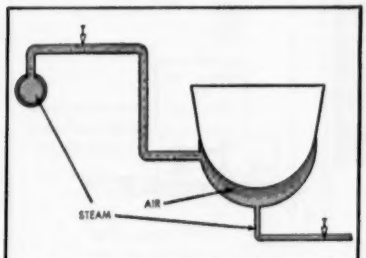


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

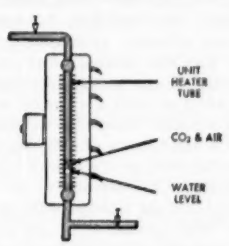


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

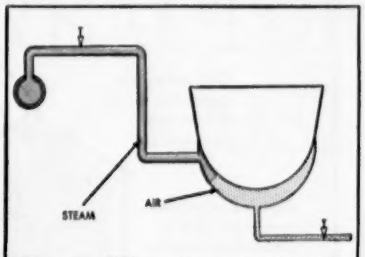


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

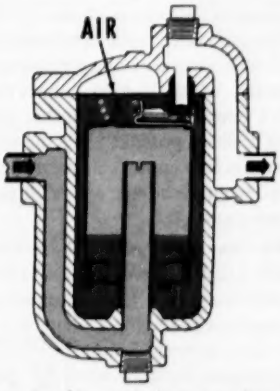
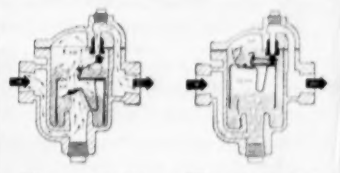


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

* * *

The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 8582 Maple Street, Three Rivers, Michigan.

ARMSTRONG STEAM TRAPS

Using Salt Efficiently

by **INTERNATIONAL SALT COMPANY, INC.**—America's largest producer of salt

How to Store Large Tonnages of Rock Salt in Limited Space

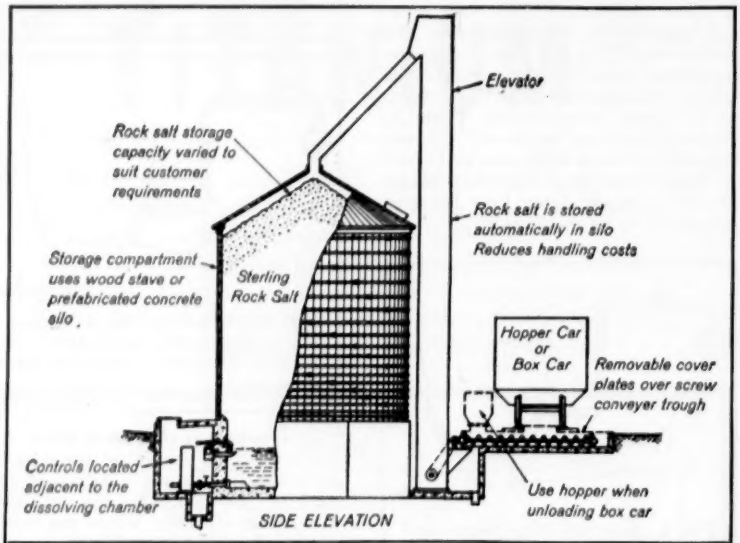
One of the best ways to increase salt-storage capacity, without taking up valuable indoor or outdoor plant space, is to install a "Silo Lixator." Developed by International, this space-saving unit—which *combines* salt storage with brine making—is especially practical where storage areas in or around the plant are at a premium.

The Silo Lixator makes excellent use of limited storage space, because it stores rock salt in a high, vertical column. The upper portion of the column stores dry salt. And the bottom of the salt column rests in a dissolving tank, where water is added to make brine. Whenever salt in this tank is dissolved to make brine, it is immediately replaced by dry salt flowing down from the upper portion of the column.

In addition—and this is an important, money-saving feature—there is ample space in the dissolving tank for brine storage. (The brine occupies the voids between the salt crystals.) This method of storing salt—with both dry salt and saturated brine present—is one form of "Wet Storage." It does away with the need for a brine-storage tank.

For storing any given amount of rock salt in dry form, ample space can be provided in the Silo portion, by building it to the proper height. The rugged steel, wood-stave, or prefabricated-concrete construction of the Silo assures long, dependable service.

Rehandling eliminated. Because dry salt stored in the Silo Lixator is dissolved to make brine, there is never any salt rehandling in the plant. A simple piping system, installed where it won't interfere with other operations, carries this brine to points of use. The brine is available simply at the turn of a valve. What's more, every drop of Lixate Brine is completely self-filtered by the rock-salt crystals at the bottom of the dissolving tank. Result: 100%-saturated brine which is always pure and crystal-clear.


Elevator
Rock salt storage capacity varied to suit customer requirements
Rock salt is stored automatically in silo Reduces handling costs
Storage compartment uses wood stave or prefabricated concrete silo
Sterling Rock Salt
Hopper Car or Box Car
Removable cover plates over screw conveyer trough
Controls located adjacent to the dissolving chamber
Use hopper when unloading box car
SIDE ELEVATION

THIS IS A TYPICAL SILO LIXATOR . . . built outside a plant so that rock-salt storage is no problem. The unloading method with this Silo Lixator is a screw conveyor underneath a railroad car.

Incoming salt shipments need no special handling. One of the more common delivery methods is the one pictured above: rock salt flows directly from a hopper car into a screw-conveyor trough, which, in turn, carries the salt to a bucket elevator. Another unloading method, possible when the elevator boot is low enough to permit gravity feed from the hopper car, is the gravity-feed chute.

Another money-saving feature: the Silo Lixator needs to be cleaned out only once every 12 to 18 months. The clean-out process is very simple: a valve or door is opened at the bottom of the dissolving compartment. All accumulated impurities are flushed through the clean-out, and the Silo Lixator is ready for use . . . needs no further attention for at least another year.

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Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all types and sizes. And we also make automatic dissolvers in metal or plastic for both kinds of salt. So we can recommend the type and size of salt most perfectly suited to your needs.

If you'd like the assistance of an International "Salt Specialist" on any problem concerning salt or brine—or further information on the many Silo Lixator designs—just contact your nearest International sales office.

International Salt Co., Scranton, Penna.
Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; and Richmond, Va.

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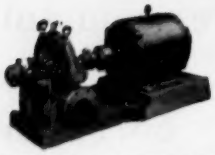
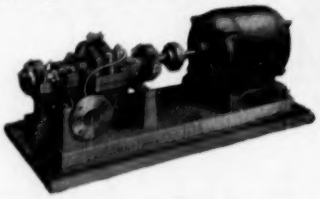
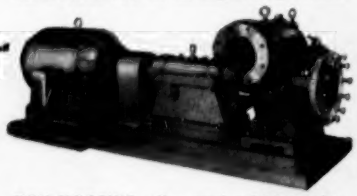


CLEAR WATER – For clear water service there is no more efficient pump than the double-suction "Buffalo" Type "SL". Its hydraulic balance, its free-flow water passages and husky construction mean economical service over many years. Capacities from 10 to 14,000 gpm. Write for Bulletin 955.



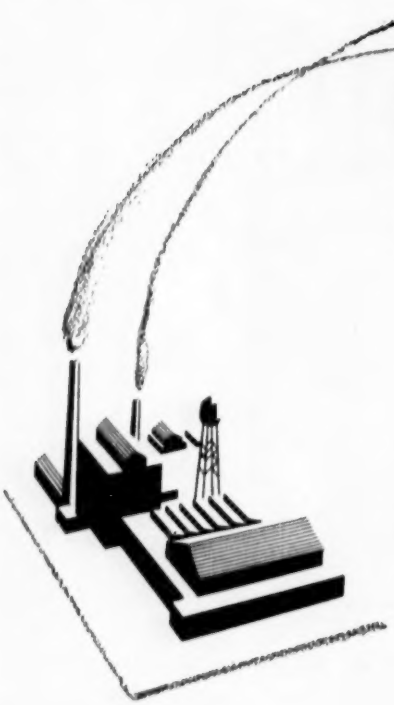
HIGH PRESSURE – "Buffalo" Type "RR" Multi-stage Pumps combine rugged strength and efficiency on boiler feed and other clear water service, against heads as high as 1500 feet, in capacities up to 900 gpm. Shafts are extra-heavy with ball bearing support on both ends — stuffing boxes are deep. Write for Bulletin 980 for all engineering details.



NON-CLOGGING – For moving high-consistency liquids, "Buffalo" Diagonally Split-Shell Pumps offer freedom from expensive shutdowns. And since efficiency does not depend on close impeller clearances, there is no problem of "wedging" and wear. Available rubber-lined for corrosive or abrasive liquids. Write for Bulletin 953.

HEAT TRANSFER – "Buffalo" Heat Transfer Pumps are specifically designed for high-temperature liquids. Successfully used in large installations, they employ special water-cooled bearings and packing, plus suitable alloys — built into our basic, efficient single-suction, solid shell design. Write for engineering details.

CHEMICAL LIQUIDS – "Buffalo" builds 10 special types of chemical pumps in a wide choice of trim for almost any corrosive, abrasive or high-consistency liquid. Above is a single-suction, full ball bearing model. Write for Bulletin 982 and check this wide selection.



Because "Buffalo" builds a *complete* line of pumps tailored to the liquid-moving applications of every industry, you get all the benefits of a custom-designed pump — without paying a "custom" price. You can match a "Buffalo" Pump to your exact conditions — and enjoy the high efficiency, easy maintenance and long life that only such a pump can deliver. Shown here are some of the types — simply write us about your problem, and we'll recommend the *right* pump!

ALSO . . . *"Buffalo" Close-Coupled Pumps, Sump Pumps, and Raw Sewage Pumps — all with the "Q" Factor, or built-in Quality which provides trouble-free satisfaction and long life in every "Buffalo" product.*

"Buffalo" PUMPS

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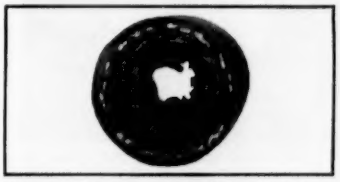
Pump lining of HYPALON withstands 30% HCl for 9 months without damage

NEOPRENE refinery hose survives a 3600-hour beating from 400° F. steam

A simultaneous test of two steam hoses, conducted at the Sun Oil Refinery, Marcus Hook, Pa., produced the results shown in the pictures below. One hose had a natural rubber tube; the other was lined with neoprene and had a neoprene cover. The steam contained traces of oil and of chemicals used in treating boiler water. It was piped directly from the boiler manifold through a Y connection to the two hoses. Bleed valves maintained the pressure on each.

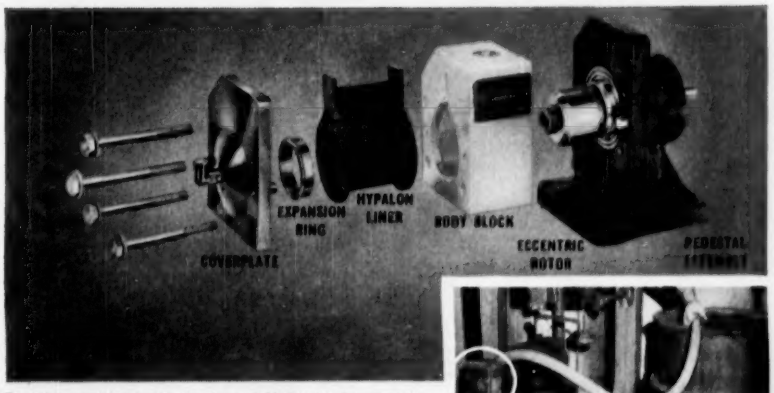


Natural rubber tube disintegrated at 3600 hours.

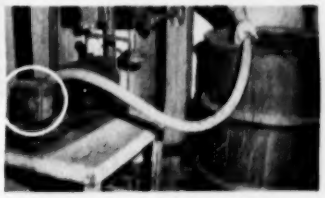
Hose with neoprene tube still undamaged after same length of time under 400° F. steam.

At 3600 hours, due to obvious disintegration of the tube, the natural rubber hose burst, ending the test (top picture). The neoprene hose (bottom picture) was still intact, fulfilling Sun's rigid requirements for refinery steam hose.

Neoprene's resistance to oils, chemicals, flex cracking, extremes of heat, sunlight and weather gives it a balanced combination of properties. This means important savings wherever you need a durable, resilient material — in hose and tank linings, for example. For more information on this Du Pont synthetic rubber, just send coupon at right.



Eccentric revolving inside the liner of HYPALON forces acid through pump from inlet to discharge.



Flexible liner of HYPALON prevents leakage . . . eliminates stuffing boxes, shaft seals and check valves.

New pump design ended acid leakage; required no maintenance in service

A small rotary pump with a flexible liner of HYPALON synthetic rubber solved a leakage problem for Hoffman-LaRoche, Inc., at its Nutley, N. J., pharmaceutical plant. The pump, used daily to transfer 30% HCl from drums to a measuring tank, is self-priming, leakproof and self-lubricating. It was installed after a succession of other pumps either failed at the packing gland, or couldn't be primed properly. When an equipment change eliminated need for the flexible liner pump, it had operated 9 months with no maintenance whatsoever. Because of this good service, Hoffman-LaRoche engineers plan installation of these pumps at other locations.

Key to the pump's success is its novel design. The tubular liner is flanged and clamped to the exterior of the molded plastic pump housing by end plates. All fluid pumped is trapped between the outside surface of the liner and the pump housing interior, eliminating shaft seals and packing glands. Inside the flexible liner of HYPALON a rotor, eccentrically mounted on the pump shaft, continuously rolls the liquid from inlet to discharge.

The combination of constant flexing and acid attack to which this pump liner was exposed had no effect upon HYPALON. This Du Pont synthetic rubber is made to perform where conditions are severe. For example, HYPALON is completely resistant to ozone, and shows unusual resistance to high (250°-350° F.) temperatures. It is also highly resistant to strong oxidizing agents and weather. For full details on the many useful properties and uses of HYPALON, just mail the coupon below.

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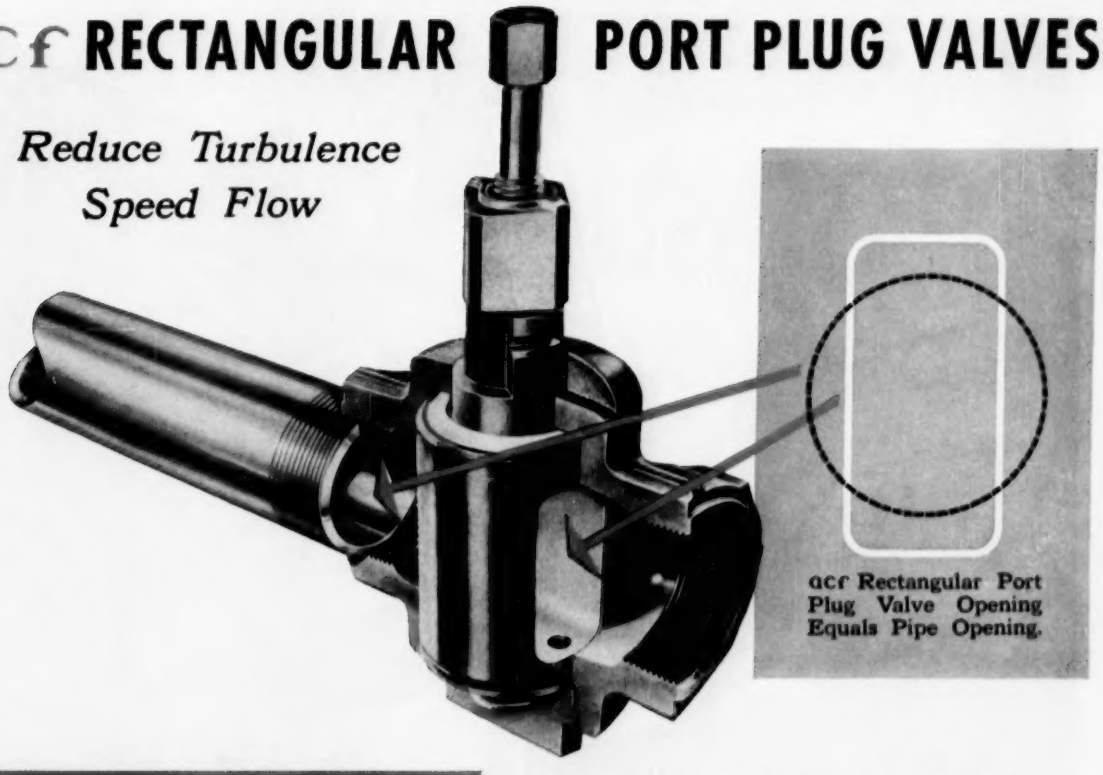

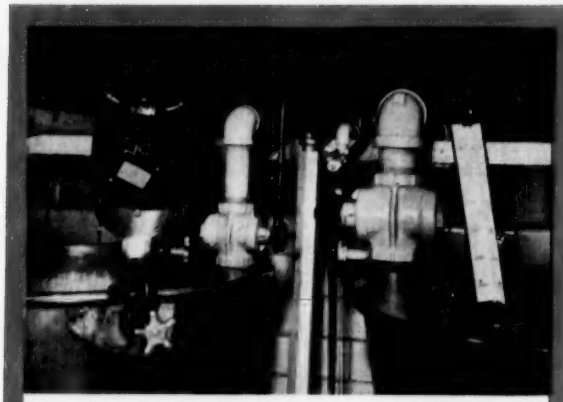

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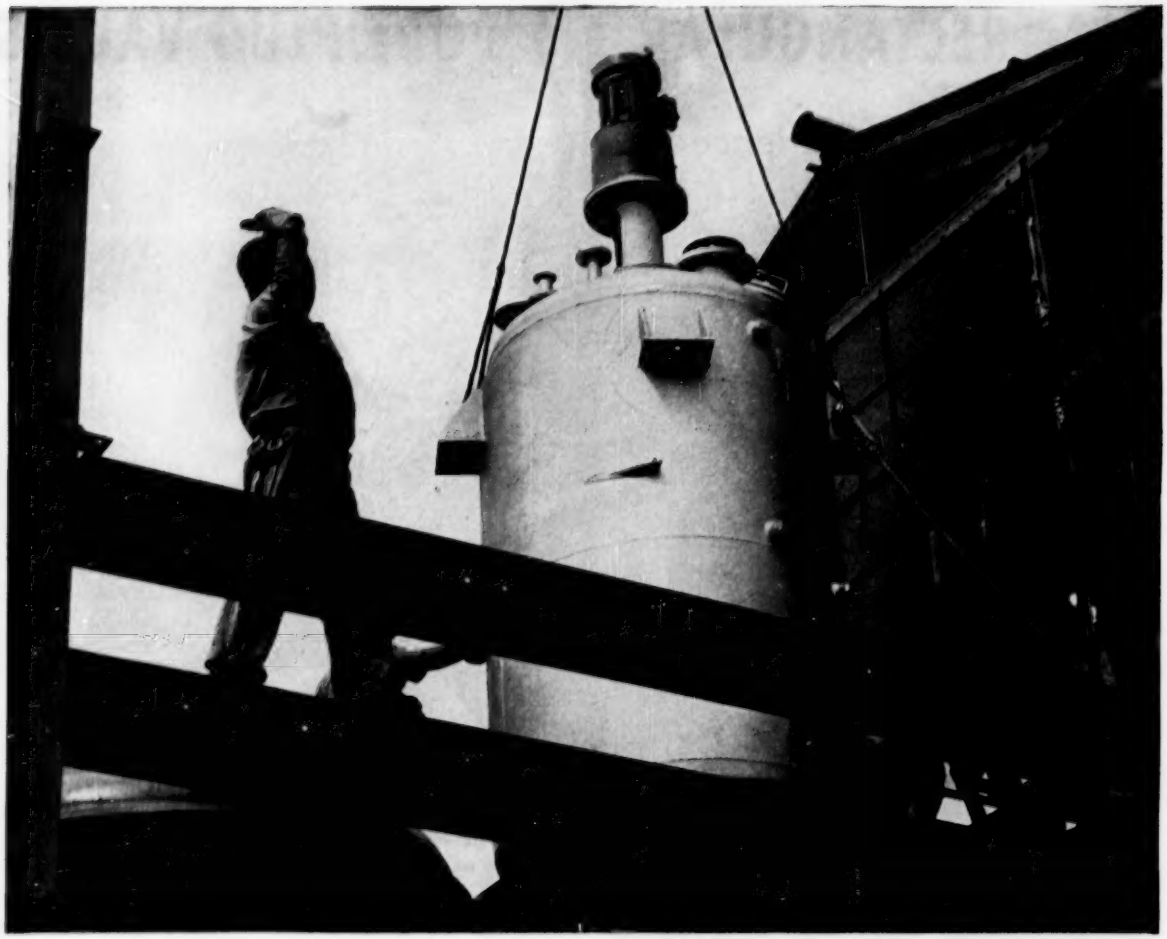


No HF corrosion with new Monel-clad vessel

Past savings prompt Catalin Corporation to add another Lukens clad steel alkylation reactor

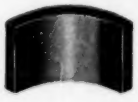
Resistance to small amounts of hydrogen fluoride resulting from the hydrolysis of boron trifluoride catalyst —at 250 deg. F. and 50 psi—is a major design requirement for Catalin Corporation's alkylation reactors.

Catalin met the requirement and kept original costs down in reactors such as this with Lukens 5/8" 20% Monel-clad steel. Monel cladding adequately resists the hydrogen fluoride. The low-cost A-285 backing steel provides the initial economy over solid high alloy. Because the kettle is jacketed, heat transfer is enhanced by the clad steel. The material also resists abrasion. Long life is assured.

Alkylating kettle of Lukens 5/8" 20% Monel-clad steel promises corrosion protection, economy at Catalin Corp.'s Fords, N. J. plant.

It's another example of how Lukens clad steels, from 3/16" gage up, are improving efficiency and saving money in the chemical industry. Only Lukens gives you a choice of 19 cladding and 11 backing metals—to meet virtually any tank or pressure vessel need. *Consult your equipment builders or write for new technical booklet, "Clad Steel Equipment." Address Manager, Marketing Service, Room 971, Lukens Steel Company, Coatesville, Pa.*

This is Lukens clad steel—not a lining, not a soldered-on surface, but a solid steel plate—one side corrosion resistant metal permanently bonded over-all to a rugged, economical backing steel.



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The Moyno "progressing cavity" pumping principle has enabled thousands of plants to pipe difficult materials that were transported by hand and other expensive means. Moyno is the only pump that can handle many abrasives, pastes, slurries, chemicals, foods, suspended solids, etc., without foaming, aerating, crushing or excessive pump wear.

As shown above, Moyno Pumps have a screw-like rotor that revolves in a double threaded stator creating progressing cavities which smoothly move material through the pump. They will pump anything that will move through a pipe . . . even plaster and non-pourable pastes!

Moyno Pumps are available in capacities up to 500 gpm and pressures up to 1000 psi.

Examine your processing methods. No doubt there are several places where Moyno Pumps can drastically cut costs. Ask us, we'll give you a frank answer. Send us an outline of your problem today! Write for Bulletin 30-CE.

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You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters.
No dust filters.
No internal lubrication to contaminate air handled.
No internal wearing parts.
No valves, pistons, or vanes.
Non-pulsating pressure.
Original performance constant over a long pump life.
Low maintenance cost.

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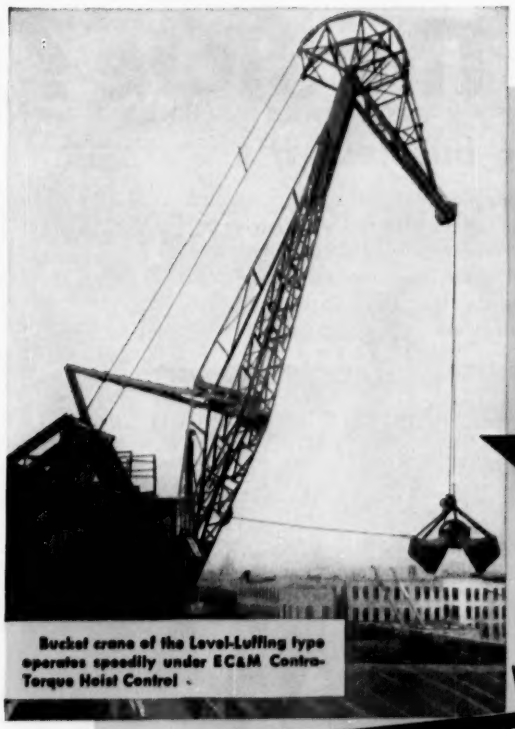
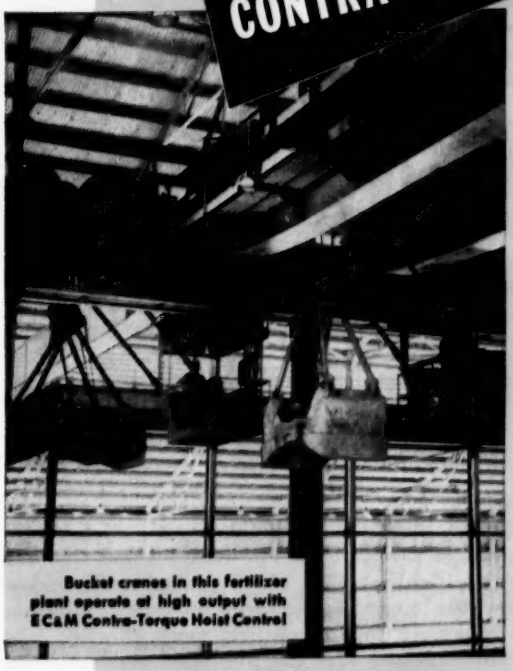


Bucket crane of the Level-Luffing type operates speedily under EC&M Contra-Torque Hoist Control.



Bucket cranes in this fertilizer plant operate at high output with EC&M Contra-Torque Hoist Control

HERE'S HOW EC&M FREQUENCY RELAY CONTROL improves A-C Bucket Crane performance

CONTRA-TORQUE

FAST GETAWAY! Quickly responsive to the frequency of the induced-rotor voltage, **EC&M FREQUENCY RELAYS** match torque requirements to the load. They get the motor up to speed quickly for lowering the bucket and moving the trolley in or out. A lot of time saved between trips!

WIDE SPEED SELECTION! These relays permit pick-up of Contra-Torque lowering connections on any master switch speed point. No waiting until last down point is reached. Wider choice of speed gives greater flexibility in clean-up operations and speeds output!

SMOOTH STOPPING ELECTRICALLY! *Off-point braking** brings the descending load to rest and the magnetic brake sets to hold the load. Electrical braking has practically eliminated holding brake wear on many cranes now equipped with this feature.

SPEED-LIMITING! Safety on all speeds. These relays (one set for hoisting and lowering) automatically shift motor connections to safeguard lowering operation with far greater skill than human hands.

***Off-point braking** to eliminate brake wear
—a new EC&M development for AC bucket cranes

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
CLEVELAND 2R • OHIO

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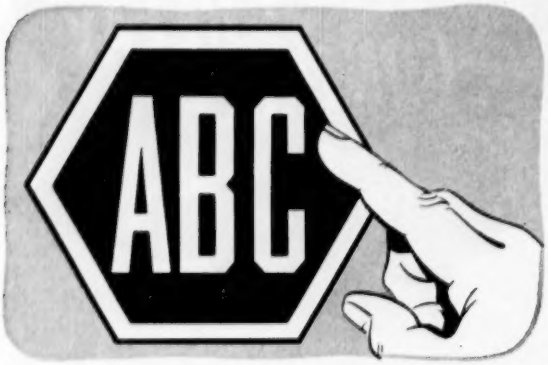
. . . in the magazine publishing business, it's

The Audit Bureau of Circulations (ABC) is a cooperative organization that sets standards of good business conduct for its publisher members. Twice each year ABC auditors carefully scrutinize the entire circulation structure and operation of every member magazine. In a very real sense, therefore, they are "minding the store" — making sure that no false or misleading claims are made regarding the size or composition of a magazine's audience.



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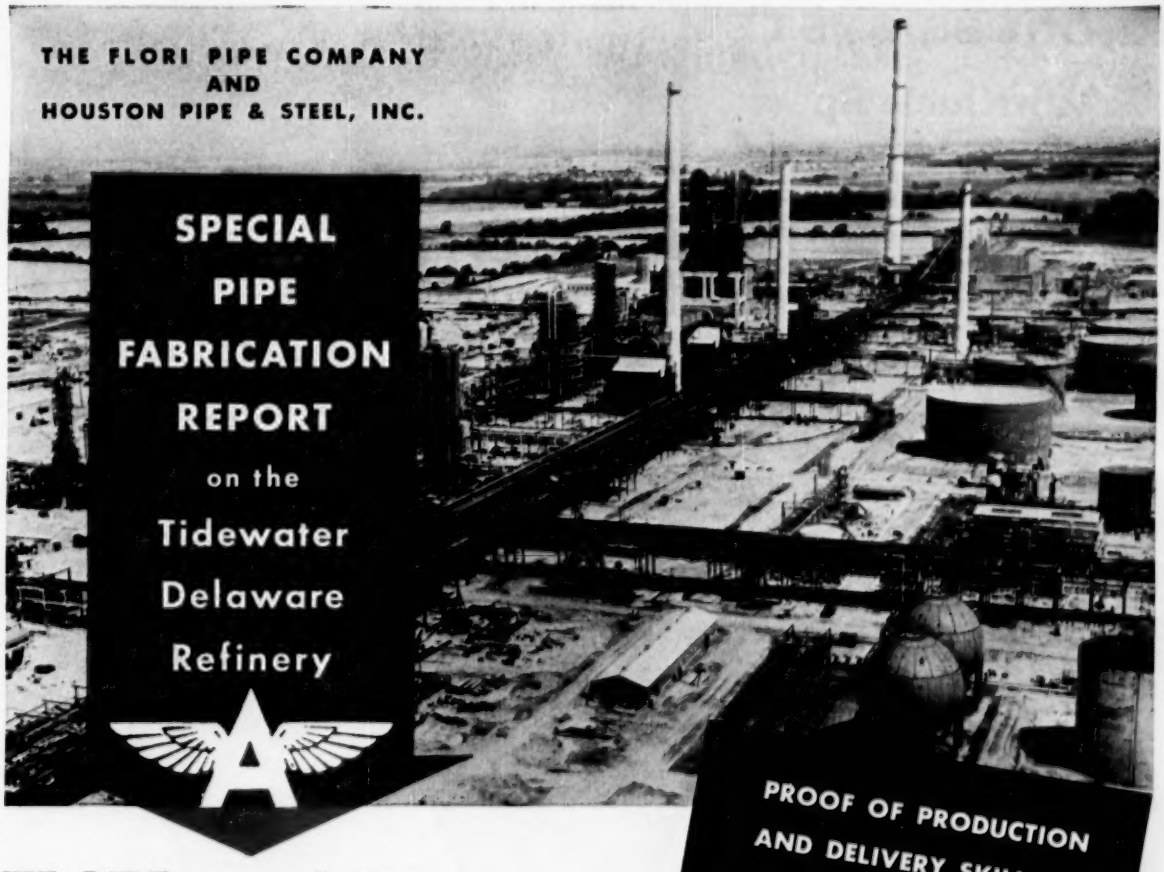
AND
HOUSTON PIPE & STEEL, INC.



FLORI completes reported largest alloy pipe fabricating project ever undertaken...

The Flori-Houston fabrication of substantially all alloy piping for Tidewater Oil Company's gigantic Delaware Refinery constitutes the reported largest alloy pipe fabricating project ever undertaken. Situated 15 miles south of Wilmington, Delaware, on a 5,000 acre site, it is the largest petroleum refinery ever built at one time.

Into this gigantic refinery went incredible quantities of fabricated pipe of numerous sizes and various metallurgical content. This project required almost 250 miles of piping. Flori-Houston delivered more than 1500 tons of fabricated alloy piping.

Approximately 1400 separate units, averaging more than a ton apiece in weight and needing more than 20,000 blueprints, were fabricated. Operational requirements in the refinery included temperature ranges to 950 F. and pressure ranges to 1350 lbs. per sq. in. To meet these requirements Flori fabricated thirteen different alloys, including nickel, monel, inconel, and incoloy.

A truly amazing feature of the project was the tight quality control program required throughout. Specifications for the job required 100% penetration—without the use of backing rings—for all welds.

This is just more proof that the Flori-Houston skill and experience can handle any fabricating job expertly, efficiently and economically.

SEE HOW THIS COMPETITIVE SERVICE AND PRODUCTION CAN WORK FOR YOU.

SEND FOR
FREE BROCHURE...
This illustrated
16-page brochure shows
every stage of the
new Flori-Houston operation.

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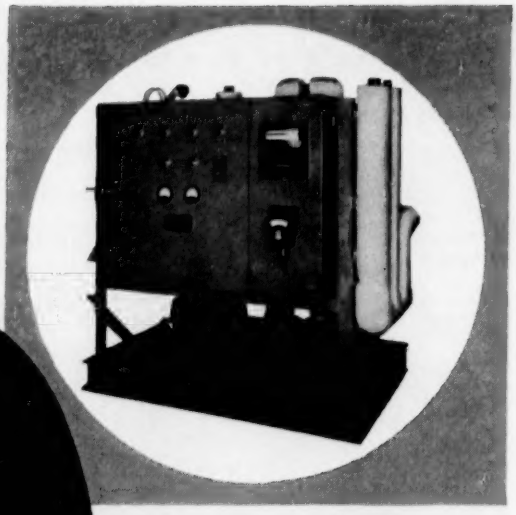
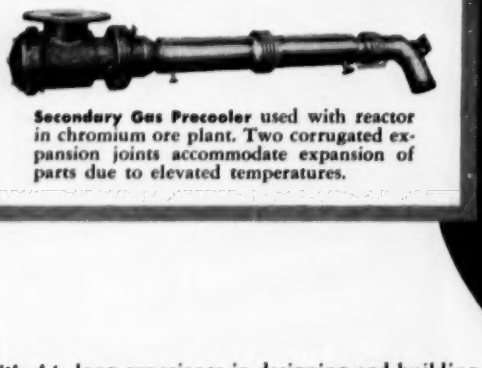
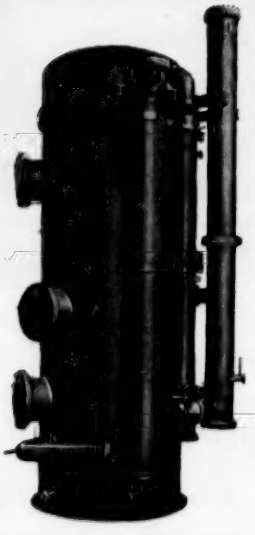


Transfer Oil Heating System, complete unit ready to install. Temperature controls maintain the oil supply temperature within ± 2° F. Available in Standard, or Group 1 Class D Explosion-proof Constructions.

Jacketed Kettle complete with agitator for grease processing.



Secondary Gas Precooler used with reactor in chromium ore plant. Two corrugated expansion joints accommodate expansion of parts due to elevated temperatures.



Large Convertor with auxiliary heat exchangers comprises a complete operating unit.

Whitlock's long experience in designing and building heat transfer equipment for the processing industries assures you the most satisfactory "in-service" equipment. We fabricate not only the standard sizes and types of heat exchangers but engineer and manufacture packaged systems, with all operating components, to perform specific tasks.

Send us your flow sheets specifying fluids, temperatures, and pressures. Our engineers will design the equipment you need. We'll supply all components, if you wish, including exchangers, tanks, pressure vessels, condensers, columns, reboilers, coils and piping. We save you the cost and trouble of obtaining the various components from many different sources and our extensive stocks of materials permit prompt shipment of your equipment. The savings are considerable, of course . . . in time and money . . . when you concentrate responsibility for your engineered equipment in a single competent producer. Write us today for further information and recommendations.

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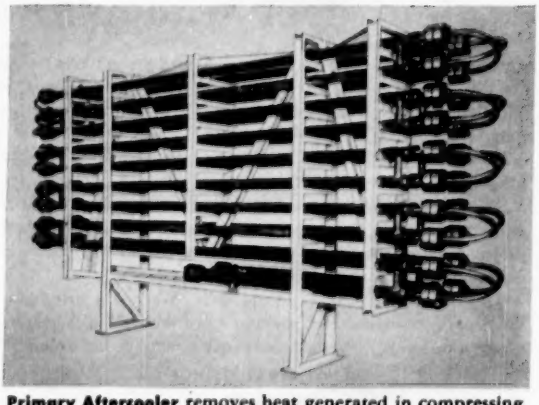


Primary Aftercooler removes heat generated in compressing ethylene gas.

Be sure to visit Booth 1181 at the Chem Show

Whitlock

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers

PUMP HOUSING is made precisely and accurately from **REFRAX®** silicon-nitride-bonded silicon carbide. It is used in handling chemical abrasive slurries where corrosion resistance is most important.

New 3000°F material replaces metals

What material combines *all* the following properties? Corrosion resistance so that it is not wet by molten aluminum, and resists attack by most acids; abrasion resistance that prevents wear by both high velocity particles and sliding heavy masses; the ability to withstand temperatures to 3000° F; hot strength so high that at 2450° F its modulus of rupture is 5600 psi?

What material *combines* all these properties? Obviously not a metal, not even a cermet. It is one of Carborundum's special refractories — REFRAX® silicon-nitride-bonded silicon carbide. This material can be precisely formed to tolerances of ±0.005 in./in. with external and internal threads. Finish resembles that of a cast iron part.

Your high temperature problem, no matter how complex it may be, can almost certainly be solved with one of the scores of super refractories by Carborundum—including precision formed parts, castable refractory cements, oxides, bromides, nitrides, and carbides, even ceramic fiber. Free engineering and application data are available for all these materials.

WRITE FOR FREE ENGINEERING AND APPLICATION DATA

Complete data on REFRAX® high temperature materials is contained in these three booklets: Refractories Magazine issue on REFRAX®; reprint of article in Product Engineering, Feb. '57 entitled "Nitride-bonded silicon-carbide bridges gap between metals and ceramics"; and Engineering Data Bulletin on REFRAX®.
Refractories Division, The Carborundum Company, Perth Amboy, N. J., Dept. H-117.

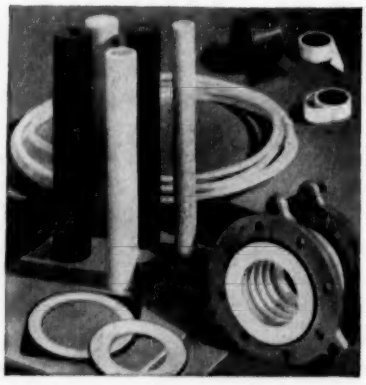
CARBORUNDUM
Registered Trade Mark

Corrosive fluids won't affect R/M FLEXIBLE THIN-WALL Teflon* HOSE

If piping corrosive fluids is your problem, look to R/M Flexible Thin-Wall "Teflon" Hose to provide an easy solution. Impervious to all industrial acids, caustics and solvents, this hose is noncontaminating and nonabsorbent. It will not harbor bacteria. It is relatively impermeable to most chemicals. It is capable of continuous service at 400°F —and keeps its toughness and flexibility at temperatures as low as −100°F.

Standard R/M Flexible Thin-Wall "Teflon" Hose is supplied in two forms: stainless steel wire braided or rubber covered. It is produced in a wide range of inside diameters and wall thicknesses. Write us for Bulletin 6700, which gives complete information, or for assistance in the solution to any hose problem.

Raybestos-Manhattan is a pioneer in the application of "Teflon." Other R/M "Teflon" products for the chemical industry include machined parts; rods, sheets, tubes and tape; centerless ground rods held to very close tolerances; stress-relieved molded tubes and rods; gaskets, expansion joints and flexible couplings; bondable tape and sheets for linings; and Raylon (R/M trade name for mechanical grade "Teflon"), which has many characteristics of virgin "Teflon." For complete details, call or write R/M.



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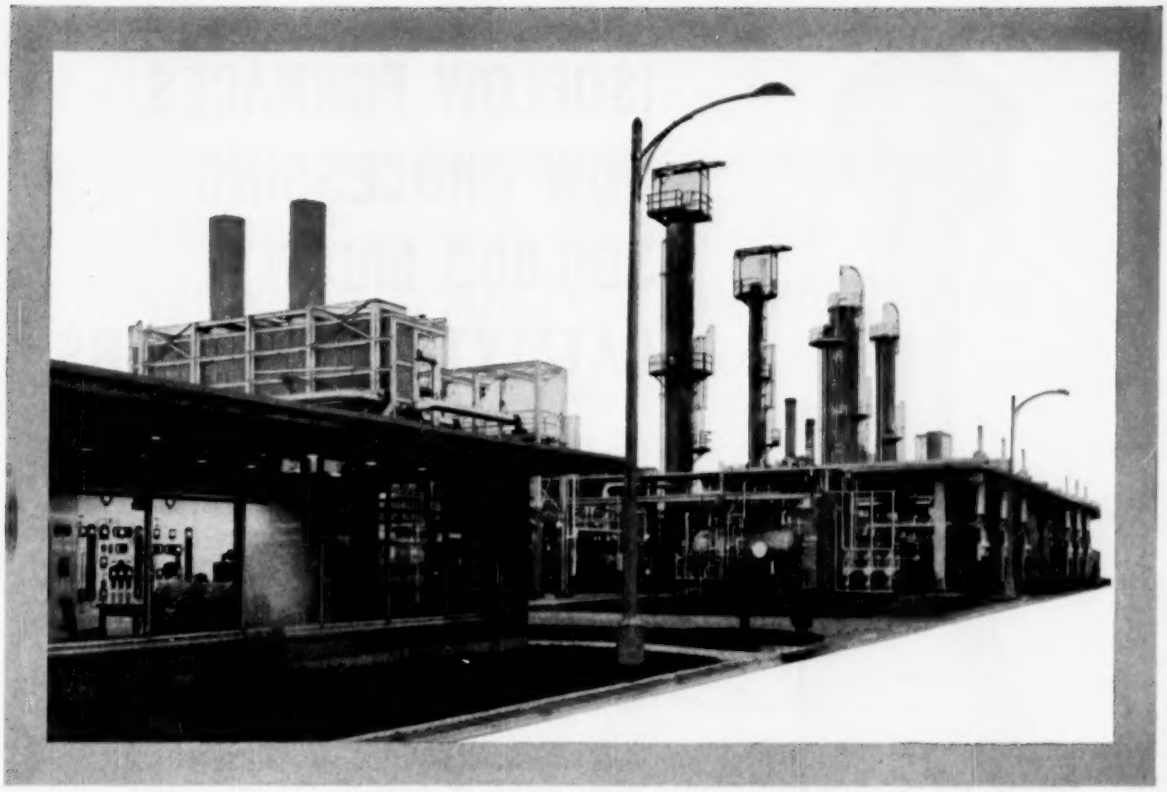

Electronic Control SAVES THOUSANDS OF DOLLARS even before start-up

Here is how: The installation of 'American-Microsen' Electronic Controls eliminated the need for a new control house when a new platformer unit was erected at the Pontiac Refining Corporation in Corpus Christi, Texas.

The existing control house (shown above) is far from the site of the new unit. Transmission distances up to 800 feet were involved—distances too great for conventional process instrumentation. But 'American-Microsen' Electronic Instruments are completely unaffected by distances up to 30 miles. Accurate dc signals are transmitted over simple 2-wire circuits with split-second speed. Consequently, Pontiac found it both practicable and economical to install the new platformer instrument panel right in the existing control house.

In addition, transistors, printed circuits and miniaturized components provide the ultimate in reliability, service life and space-saving simplicity. These are but a few of many reasons why 'American-Microsen' – the all-electronic system that uses only three units – is widely preferred for measurement, transmission and control. Write for literature and ask that a sales engineer from our nearby district office call and explain fully. No obligation, of course.

MANNING, MAXWELL & MOORE, INC.

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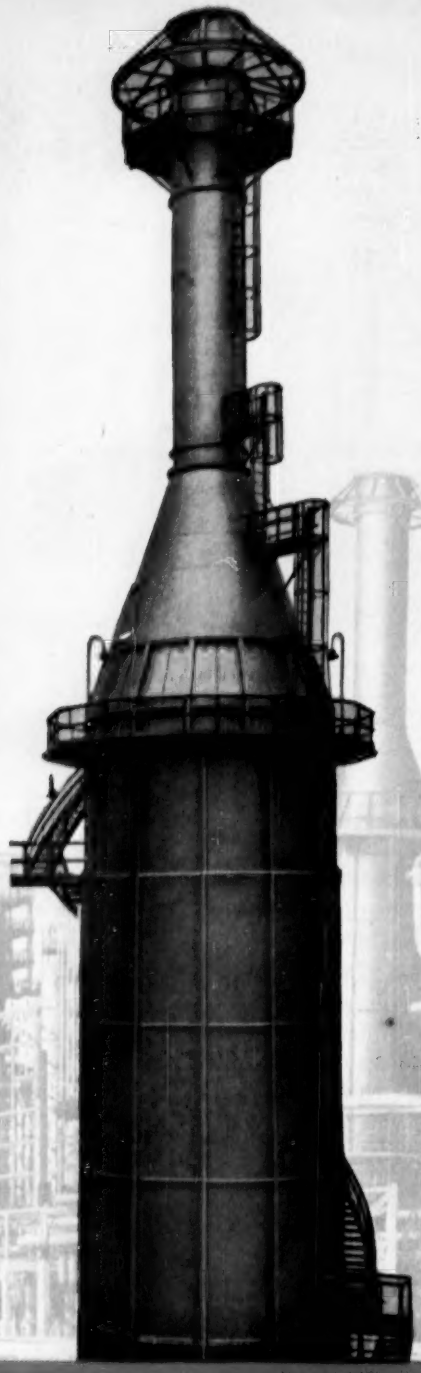
INDUSTRIAL CONTROLS DIVISION • STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL



ISOFLOW FURNACES NOW PROCESSING 300,000 b/d IN CATALYTIC REFORMERS

. . . and more "Isoflows" are being installed in the largest reformers under construction

The continuous production of high octane gasoline by catalytic reforming demands sturdy, efficient, soundly designed equipment. This is especially true of furnaces.

The wide acceptance of Petrochem-Isoflow furnaces is due to their high efficiency, dependable performance even under overload conditions, and their long service life. When you apply all the specifications and operating requirements to direct fired furnace design you'll find Petrochem-Isoflows most economically desirable, by any comparison.

For petroleum, chemical and allied process industries there's a Petrochem-Isoflow furnace for any duty, temperature and efficiency.

The unique design and operating features which have led to the wide acceptance of Petro-Chem furnaces include:

- **Uniform Heat Distribution**
- **Maximum Fuel Efficiency**
- **Low Pressure Drop**
- **Low Maintenance**
- **Zero Air Leakage**
- **Minimum Ground Space**
- **Simplicity of Design and Construction**
- **Short Length of Liquid Travel**
- **Series, Multipass, all parallel flow**
- **Excess Draft for High Overload**

PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

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"NATIONAL" *as the Leader in the Field of*
PERFORATED APRON-TYPE CONVEYOR DRYERS

Famous names among the manufacturers and processors of chemicals, fibers and allied products are proudly listed in the growing roster of "NATIONAL" customers.

These companies, by their selection of "NATIONAL" Perforated Apron-Type Conveyor Dryers, have demonstrated their belief in the outstanding leadership which "NATIONAL" has earned in the design and construction of this and related types of drying and conditioning equipment.

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• *Watch This Space in Future Issues for Case Histories*
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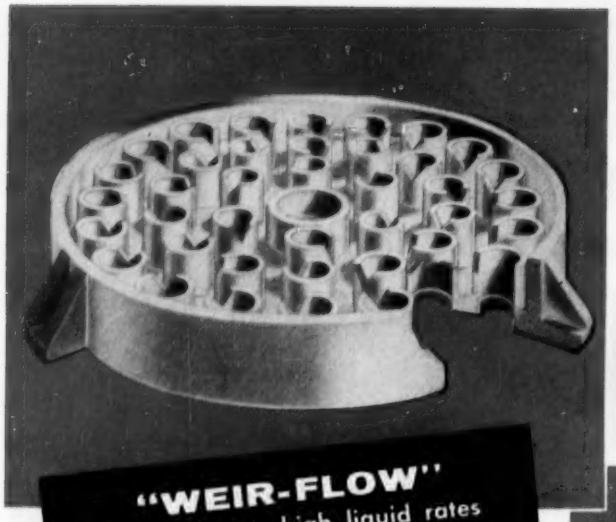
TWO NEW TOWER DISTRIBUTORS



"WEIR-FLOW"
for medium-to-high liquid rates

"MULTI-LEVEL"
for low-to-medium liquid rates

The development of newer tower packings (such as Intalox Saddles and Metal Pall Rings) brought into sharp relief the need for better liquid distributors to permit full utilization of the better performance characteristics of these packings.

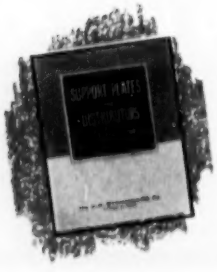
U. S. Stoneware developed, pilot-plant and field-tested, a number of distributors. Two, in particular, showed far superior operating characteristics, and are now offered as standard items in our line.

The "WEIR-FLOW" Distributor: Cylindrical risers with "V" notches are used as downcomers for the liquid, permitting greater flow as the head increases. Provides uniform liquid distribution over a wide range of medium to high liquid rates. Made in chemical stoneware and chemical porcelain in a range of sizes to fit towers up to 8 feet in diameter; also in carbon steel or stainless steel for towers as small as 6" i.d., and in larger diameters to fit customer's specifications.

The "MULTI-LEVEL" Distributor: Essentially a tray with a perforated bottom, but the perforations drain at three different levels. Provides uniform liquid distribution over a wide range of low to medium liquid rates. Made in chemical stoneware and in chemical porcelain for towers from 24" to 60" in diameter.

SEE THEM AT THE CHEM SHOW, NEW YORK COLISEUM, DECEMBER 2-6, BOOTH 111

102-F



New Booklet on SUPPORT PLATES and DISTRIBUTORS

New 24 page booklet just off the press describes our complete line of support plates and distributors. Write for it today. Ask for Bulletin TA-30.

U. S. STONEWARE

AKRON 9, OHIO

Chemical Engineering

Developments

What's new in chemical processing 135
Continuous ion exchange for uranium recovery . . . Kaolin catalysts woo refiners . . . Energy frontier: free radicals.

At half the usual cost: ClO_2 142
This flowsheet capitalizes on a wealth of on-stream experience abroad and boasts still more improvements.

Taming phenolic waste streams 148
A rotating-disk extractor coupled with a pair of new solvents—that's Barrett's winning new dephenolization team.

Here's another waste-cutting scheme 154
It's a new mechanical compacting process that steps up off-grade dusty materials into marketable sizes.

You'll save on design and construction 158
Dewey & Almy did—when it let its lab serve as pilot operation for an engineering modeling technique.

A new structural material makes its debut 162
Swedish-bred concrete, foamed via chemical generation of H_2, is paving the way toward a new branch of ceramics.

If you need a tough rubber 170
Compared to other rubbers, this urethane tacked up an impressive score in abrasion and oil resistance tests.

This conveyor serves two needs 182
It's modified to handle the dual role of classifier and conveyor handling heavy tonnage flow.

Is the paper industry spending too much, too fast? . . . 202
Greedy demands in '55 prompted hefty expansions. Now, only keener marketing can keep mills really rolling.

Copying machines to the rescue 206
With national production booming away, the accompanying avalanche of paperwork is now an industrial headache.

NOVEMBER 1957

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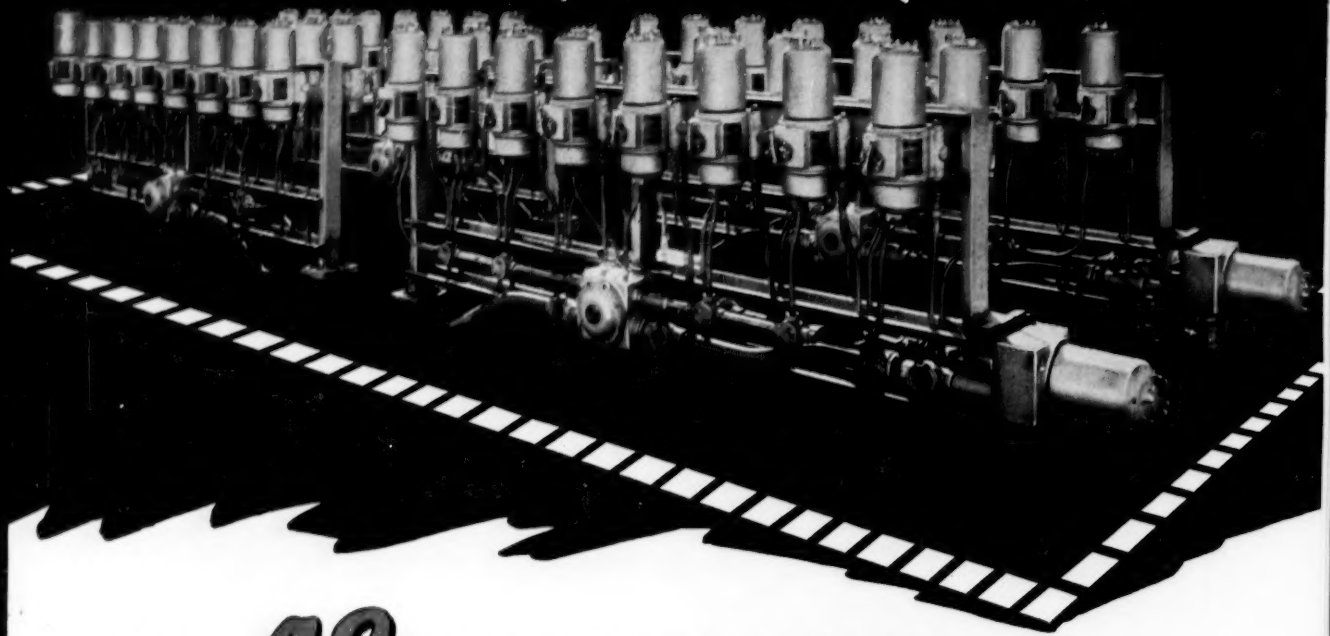
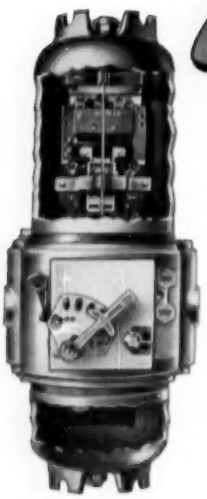
CROUSE-HINDS
Condulet* motor controls
Occupy Less Space!





48 Explosion-Proof Combination Motor Starters and Circuit Breakers . . . *in a 25 ft. x 6 ft. Area!*

Crouse-Hinds Condulet* Type EPC Motor Starters and Circuit Breakers are explosion-proof, dust-tight (dust-ignition-proof) and weather-resistant (raintight).

Lightweight cast aluminum construction for easy installation without use of lifting equipment.

Seven Conduit entrances simplify installation.

Built-in push button stations and selector switches are available.

Starter sizes 0 to 5. Circuit breakers 50 to 600-amp. frame sizes.

In the installation shown above, 48 Crouse-Hinds Condulet* Type EPC combination motor starters and circuit breakers are compactly arranged in four racks.

If necessary, the 25 ft. x 6 ft. area used could have been cut in half by installing the Condulet motor controls in two tiers. Or, *twice* as many Condulet controls could have been installed in the same area, if required.

The *vertical design* of Crouse-Hinds motor starters, circuit breakers and combinations allows them to be installed only ¼" apart. This compactness produces savings in the construction of steel mounting racks, and in the use of premium floor space.

● **For help in solving a space problem, see your Crouse-Hinds distributor . . . or call the nearest Office listed below**

*Registered

A NATIONWIDE **DISTRIBUTION** exclusively through **ELECTRICAL DISTRIBUTORS**

CROUSE-HINDS COMPANY

Main Office and Factory: Syracuse, N. Y.

DEVELOPMENTS . . .

NOVEMBER 1957

Chementator

C. H. CHILTON

√ **Dow will bring on stream at Freeport (Tex.) early next year a plant for continuous production of Versene chelating and sequestering agents.**

√ **Less power, lower maintenance are promised by Vulcan Iron Works' integration of rotary kiln riding rings, drive gears, trunnions and thrust bearing into a sealed unit.**

√ **Columbia-Southern plans to enter sodium chlorate production via its Canadian subsidiary, Standard Chemical, using a new cell design. Project ties in with recently disclosed chlorate-based chlorine dioxide wood pulp bleaching process.**

√ **Pentane isomerization for octane improvement will go commercial early next year at Phillips' Borger (Tex.) refinery, using UOP's Penex process.**

Continuous ion exchange now at work

First commercial-scale use of continuous countercurrent ion exchange for uranium recovery started last month at Maybell, Colo. Union Carbide Nuclear Co.'s plant there is scheduled to reach full output by January.

Ion exchange system at Maybell is modified Infilco-Techmanix design (*Chem. Eng.*, May 1957, p. 160), which recovers uranium from either pulp or clear liquor, claims capital, operating and maintenance savings. On pulps, system tolerates higher solids content than do basket resin-in-pulp techniques.

Anion exchange resin and pregnant pulp or liquor flow countercurrently through a series of exchange or elution contactors adapted from Infilco's Aero-Accelator.

Resin and feed entering a contacting stage mingle in the pipe leading to a distributor at the bottom of the tank. Air, entering through porous bottom panel, agitates and lifts resin-pulp slurry up a central well. Overflow from this well enters a peripheral settling zone, allowing resin to drop into thickening compartment and resin-free pulp to discharge into a launder. Thickened resin may be recirculated to the contacting zone or transferred by air lift to the next stage.

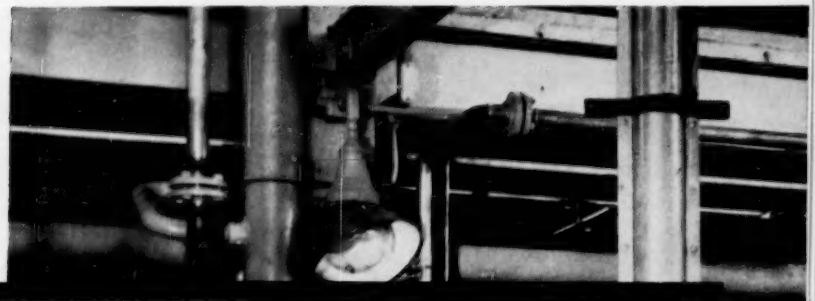
Kaolin catalysts woo oil refiners

Cracking catalysts based on kaolin, a natural aluminum silicate, are bidding for a sizable share of the petroleum industry's insatiable appetite for catalytic materials.

A pelleted kaolin catalyst is now being produced by Minerals & Chemicals Corp. of America and marketed by Houdry Process Corp. under the label of "Houdry-Minerals." This material is suitable for use in moving-bed reactors (e.g., Houdriflow, TCC, Socony Airlift).

MCCA built a 100-ton/day pelleted catalyst plant at Attapulgus, Ga., last year. The plant has been plagued with operating diffi-

(Continued on page 138)



THE OLIVER HORIZONTAL FILTER

A standard unit in a job-engineered application at HOOKER ELECTROCHEMICAL

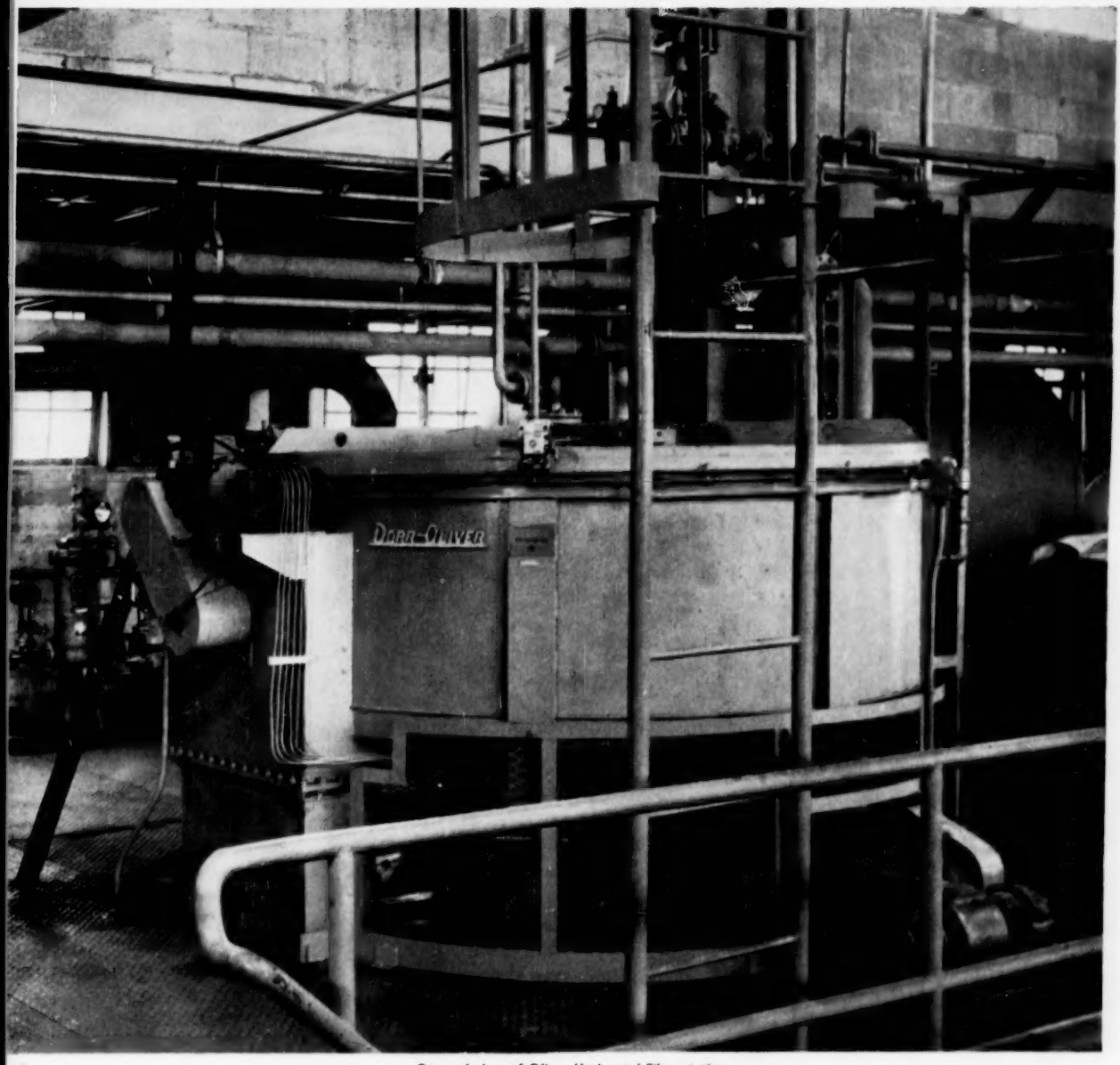
One of the most unusual and successful applications of the Oliver Horizontal Filter is at the Niagara Falls, N. Y. plant of Hooker Electrochemical Company.

This installation is unusual due to the highly specialized nature of the Hooker Process. The unit handles the dewatering, multi-component solution washing and final dewatering steps prior to thermal drying of HET Acid,* an ingredient of Hooker's flame resistant polyester resin Hetron*. Basically constructed of stainless steel all direct contact components are coated with a non-contaminable, corrosion-resistant plastic. Product conditions require that the filter hood be of a liquid seal-vapor-tight design providing a completely closed air return system. Control is automatic and viewing ports with illumination are provided for full visibility through the entire cycle.

The ability of the unit to provide sharp filtrate separations ideally suits the Oliver Horizontal Filter for solution washes when several filtrates must be kept separate. This feature along with many other facets of the versatility inherent in the Oliver Horizontal Filter, such as high capacity per unit area and multi-stage counter current wash, qualifies the standard unit for such highly specialized applications.

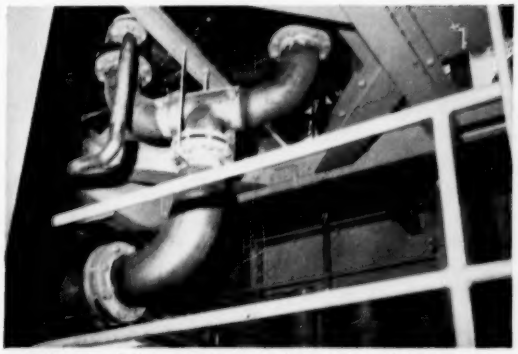
The Hooker Electrochemical installation is an excellent example of Dorr-Oliver ability to provide the equipment to fit the job. For further information on the Oliver Horizontal Filter, write to Dorr-Oliver Incorporated, Stamford, Conn. Ask for Bulletin No. 7201.

*T.M. Hooker Electrochemical Company



General view of Oliver Horizontal Filter station.

Access port showing accessibility of interior components, inner scroll support bearing not in place; note vapor-tight construction.



Underside of filter showing accessibility of integrally mounted valve and filtrate piping.

culties, most of which have been due to mechanical failures of conventional equipment, such as boilers and compressors. Little trouble has been encountered in successfully achieving process conditions, and with equipment headaches now largely out of the way, company engineers are concentrating on improvements in product quality and plant efficiency.

Competitive catalysts are based on bentonite or halloysite—naturally occurring aluminum silicates, like kaolin—or are made synthetically. The three natural minerals differ in their Al_2O_3-SiO_2 ratios and crystal structures. MCCA claims that its kaolin catalyst performs as well as synthetics, while costing less than two-thirds as much.

Next on MCCA's program for commercialization: a fluid (non-pelleted) kaolin catalyst. While denying rumors that a 25-ton/day semicommercial fluid catalyst plant was under construction, a company spokesman confirmed MCCA's ambitions to get into this attractive field.

Infrared snapshots measure tank levels

Using thermal photography, industry soon may see broad new vistas. A far-infrared camera introduced this month by Barnes Engineering Co., Stamford, Conn., produces a photographic image of the thermal condition of any object, no matter how cold.

Outstanding characteristic of the new camera is top performance in the 0-500 F. range. Recording differences as small as 0.4 F., it adjusts to cover either broad or narrow ranges. Even the temperature differential between a block of dry ice and a block of water ice produces a thermal image.

Applications of thermal photography appear limitless. For instance, the difference in infrared energy radiated from filled and empty sections of an oil storage tank produces a thermal image and, therefore, a means of tank gaging. Thermal pictures of process units may indicate inefficient conditions which would otherwise go undetected. Pictures of electrical equipment can point to trouble from localized overheating, lead to correction before breakdown.

Barnes's camera produces finished image on Polaroid Land film within 3 min. Camera scans like a TV camera, building up the image in a series of horizontal lines.

Finished image roughly resembles a visible-light photograph. Coolest portions of the object appear black. Areas of increasing apparent temperature range through gray to white. A reference series of gray tones superimposed along one edge of the picture correspond to accurately known equivalent black-body temperatures.

Free radicals: Next energy frontier

Though boron-based propellants are barely getting off the ground themselves, pioneering investigators are now turning to a still-higher-energy source—the evanescent free radicals.

This September, researchers compared notes at a free-radical symposium in the nation's capital. National Bureau of Standards and some 30 colleges are currently working in this field. But at least two industrial firms —Aerojet-General and Phillips Petroleum— are also actively engaged.

In shooting for the bluest skies, free-radical research is perforce rather "blue-sky" itself. But with free radicals able to deliver a punch far above that which could be tapped from the most exotic chemical propellant, there's a powerful incentive to determine the economics and feasibility of free radicals as ultra-energy rocket fuels.

Free radicals (e.g., methyl) release energy upon recombining to stable molecules (e.g., ethane). To harness this energy, molecular fragments must first be produced, then captured and stored.

Chief means of rupturing molecules are via high-energy radiation, ultraviolet light and electrical discharge techniques. And by swiftly dropping temperature to −450 F., the free radicals can be frozen in the active state and held there for a matter of hours.

Aerojet uses a 1,000-curie cobalt-60 gamma-ray source to do the job, now plans to install a 1-million-curie machine. NBS has developed a scheme which employs a 2,500-megacycle electrical discharge. Both capture the resulting free radicals on a surface cooled by liquid helium or nitrogen.

A tough technical problem facing researchers is how to get a high-enough concentration of free radicals. Aerojet estimates that a useful product must contain at least 10-15%. Yet best concentrations to date run less than 1%.

Another problem: How to hold on to free

(Continued on page 140)

HOW TO "SPEND" SULFURIC —AND HAVE IT, TOO!

Not everyone can do this. But when you can, the dollar savings mount up.

Many uses of sulfuric acid and oleum result in substantial quantities of relatively high-strength, impure acid which present problems of handling and disposal. This is particularly true if you use it as an alkylation catalyst, or for sulfonating white oils, synthetic detergents, etc.

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radicals for usefully long periods. Present freezing technique preserves them long enough for lab studies. But for commercial applications, other methods will be needed.

Fermentation: New route to glycerine?

Glycerine via fermentation—subject of process research and development for many years—takes a step nearer commercialization with acquisition of licensing rights to such a process from Imperial Chemical Industries by Scientific Design Co., New York.

Sparked by its basic interest in glycerine as a raw material for dynamite manufacture, ICI built a fermentation pilot plant at Glasgow to explore this potential route to glycerine independence. Process involves the controlled fermentation of molasses, followed by recovery of glycerine and coproducts—acetaldehyde and ethyl alcohol. Recovery steps include steam stripping, evaporation, solvent extraction and distillation.

SD and ICI put their heads together last year, worked out an arrangement whereby SD contributes its process engineering and plant design experience in return for licensing rights. SD has now completed its engineering and economic studies, is ready to talk business with anyone interested.

For U.S. conditions, fermentation glycerine must overcome a tough economic barrier, requiring a much more favorable spread than now exists between cost of molasses and cost of propylene and chlorine, chief raw materials for making synthetic glycerine. In other respects, such as capital investment and general processing costs, says SD, fermentation and synthesis are closely competitive.

Are optimized processes only a dream?

Have widely heralded process-stream analyzers won acceptance as essential control elements? For the most part, no.

Granted that a number of installations now are operating, they represent mainly new tools for research on a plant scale. Expressing this view before the annual Instrument Society of America meeting in Cleveland, Perkin-Elmer's Van Zandt Williams contended that concentration-sensing instruments need further extensive development before they can become integral components of completely automatic process plants.

That's also true for computers and other electronic gear vital to optimized processes. While all these elements exist and the principles underlying advanced systems are known, design into finished optimized systems will be a formidable task.

Yet, many feel the time is ripe to undertake such tasks. With process systems growing steadily more complex, there is urgent need to optimize them. Only then will capital outlays provide maximum return and protect profit margins.

Prime tool in achieving optimized processes will be "systems engineering." Embracing every scientific and technical concept, systems engineering integrates an entire project to arrive at one over-all answer. Then, it breaks down this answer into defined units which may be selected to function compatibly within the whole.

Pulpers look to wood sugar recovery

Efforts to recover commercial chemicals from "the other half of the tree" will reach a new pitch when Sulphite Pulp Manufacturers' Research League starts up a wood sugar pilot plant in its new building, now nearing completion at Appleton, Wis.

Such sugars as mannose, galactose, glucose, xylose and arabinose are present in substantial quantity in spent sulfite liquor. A 100-ton/day pulp mill could recover as much as 20 tons/day of these materials.

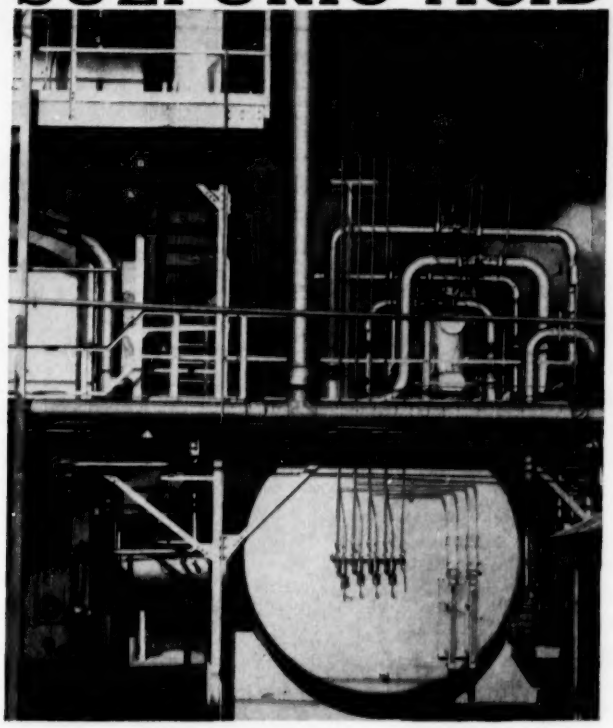
Inasmuch as these sugars show a high BOD, their removal from spent liquor would also go a long way towards lightening stream-pollution loads.

The league's "reactive solvent extraction" process stems from seven years' work in the laboratory and in a small-scale pilot plant. It involves extraction of spray-dried spent-liquor solids with acidified dry acetone. The sugars are extracted as a group in the form of their di-O-isopropylidene derivatives. Individual sugars are then isolated via various separation techniques, such as steam distillation, chloroform extraction and acid hydrolysis.

One modification of the process is being considered for commercialization by one of the league member mills. "However," cautions Averill Wiley, league's technical director, "much remains to be done before we can know whether commercialization actually will be justified and achieved."

For more on DEVELOPMENTS.....142

SULFURIC ACID



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Hypochlorite Products
Methanol
Muriatic Acid
Nitric Acid
Polyamines
Soda Ash
Sodium Chlorite Products
Sodium Methylate
Sodium Nitrate
Sulfate of Alumina
Sulfur (Processed)
Sulfuric Acid

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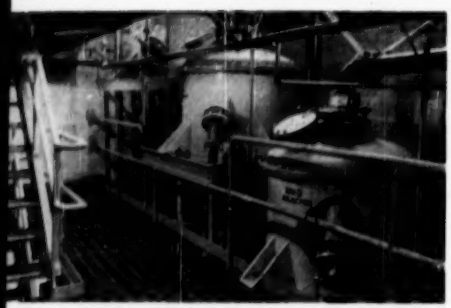
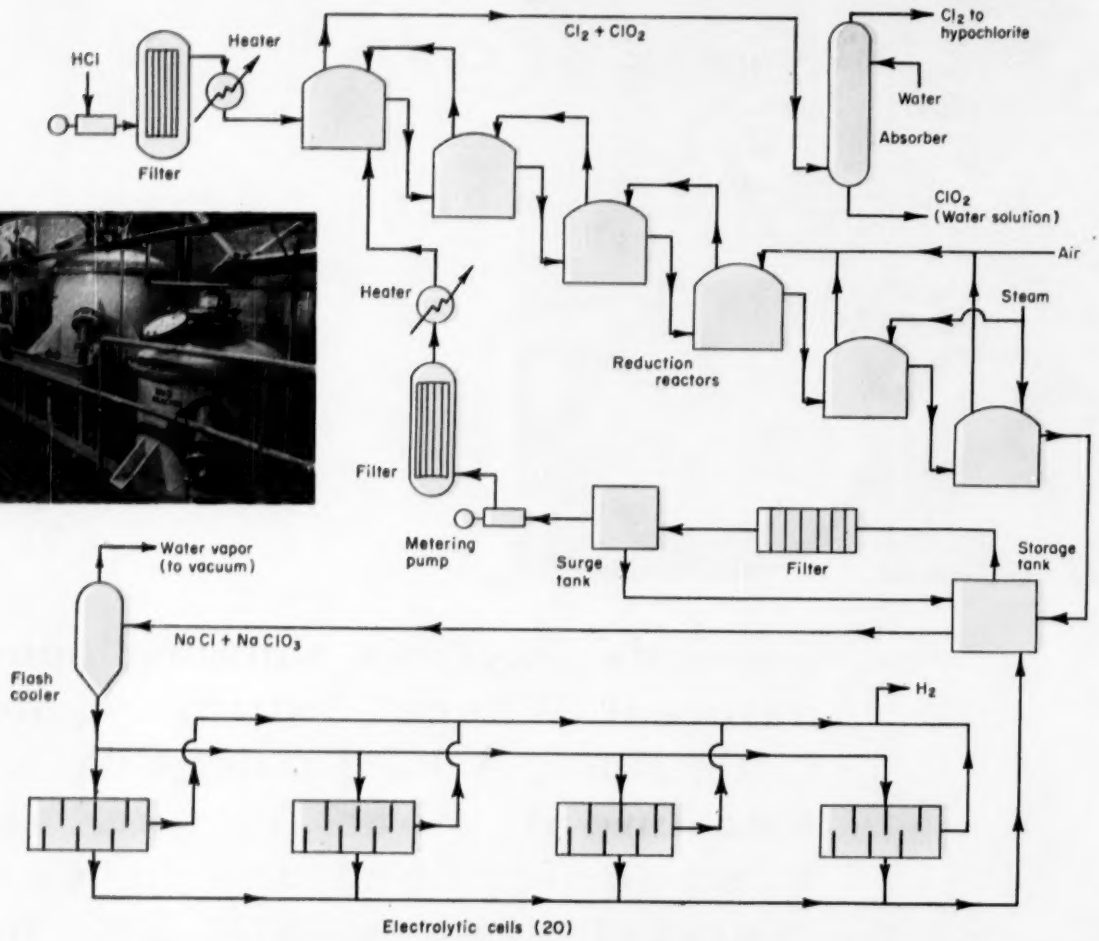
Olin Mathieson Chemical Corporation, Industrial Chemicals Division, Baltimore 3, Md.

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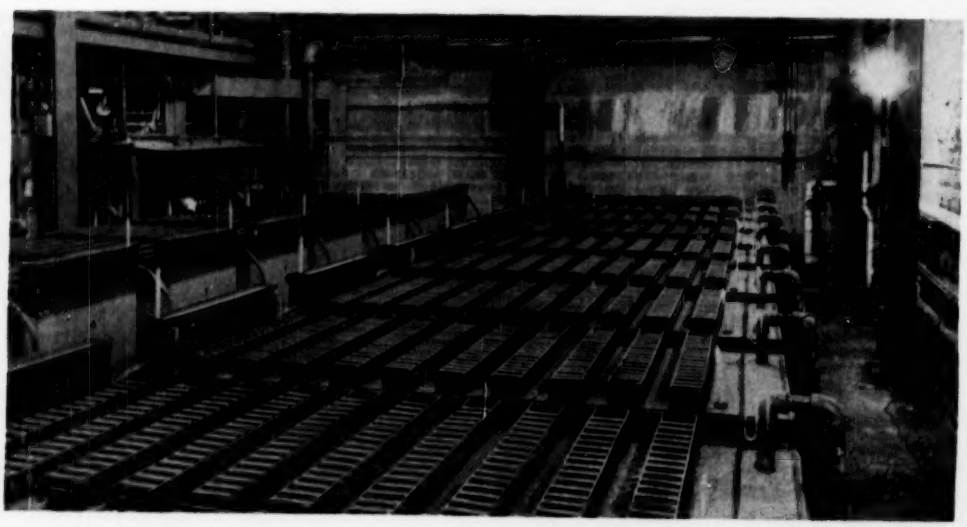
Surge tank
Filter
Storage tank
Water vapor (to vacuum)
Na Cl + Na ClO_3
Flash cooler
H_2
Electrolytic cells (20)



Integrated Process Gets Low-Cost ClO_2

Built-in electrolytic production of sodium chlorate, followed by reduction with HCl, endow this process with a powerful economic appeal.

In chemical technology, as in most other fields, experience is a masterful teacher. And when it comes to the Day-Kesting process for making chlorine dioxide (devised by G. A. Day of Brown Co. and E. E. Kesting of Elektrochemische Werke), that's the story of its brand-new commercial life.

In its U. S. debut last year in a 1.5-ton/day, $625,000 unit at Brown's Berlin, N. H., kraft pulp mill, the process capitalized on a wealth of on-stream experience from six recent European installations.

But in engineering its new unit, Brown and designer M. H. Treadwell Co. (New York) had to adapt that experience to American industrial conditions. And today the flowsheet that's being offered for licensing by Treadwell incorporates still more engineering improvements gathered from Brown's year of operating experience.

▶**Half the Cost** — There's a pretty persuasive reason for showering a lot of attention on the Day-Kesting process and grooming it to the peak of its potential. This process, according to Brown, can turn out chlorine dioxide at a cost one-half that of any competitive process—10-13¢/lb. vs. 23-26¢/lb.

What makes this possible? Like other ClO_2 processes that have been spawned by wood pulpers' growing enchantment with ClO_2 bleaching (see *Chem. Eng.*, July 1956, pp. 134-136), this route produces the dioxide via reduction of sodium chlorate. But thriftily unlike them, it does not need a raw material stream of costly chlorate; it makes its own.

▶**HCl Plus Power**—The Day-Kesting process requires, after startup, essentially only hydrochloric acid and electrical power for its raw materials. Other processes consume, in addition to sodium chlorate, such reagents as sulfur dioxide, sulfuric acid and methanol.

As shown in the flowsheet (*opposite page*), the reaction which produces chlorine dioxide involves the reduction with HCl of sodium chlorate in a circulating stream of liquor. Chlorate is present in excess in order to wring the highest efficiency out of the reaction. Products of the reaction are chlorine and chlorine dioxide (which are stripped out by an air stream) and a spent liquor containing sodium chloride and left-over chlorate.

This $NaCl$-$NaClO_3$ solution makes an ideal electrolyte for the electrolysis of sodium chloride to chlorate. So it cycles through a bank of electrolytic cells to regenerate the chlorate for the reduction reaction.

▶**Quick Payout** — In the debit column, at least on first glance, stands the additional investment in the electrolysis facility. But Treadwell's Bob Spitzer points to some dollar figures to stress that this isn't a serious handicap.

A 1.5-ton/day unit like Brown's cost roughly $315,000 more than most competing processes' installations. But in turning out the dioxide at half price, the plant reaps an annual savings of $130,000. Thus in about 2½ years it will pay off the difference. In larger plants, Spitzer estimates, these figures become even more attractive; 5-ton/day and larger units can pay out the extra investment in about 20 months.

▶**Changes to Come**—Still, it is chiefly the higher capital cost of the process that has spurred Brown and Treadwell engineers to exploit every lesson learned from operating experience and to keep them revamping the flowsheet. Here are some points where future Day-Kesting plants will differ from Brown's U. S. prototype:

- Flash cooler that now concentrates solution recycling from reduction stage to electrolysis will be eliminated. A large and costly piece of equipment in itself, this unit forced an added 45 ft. of building height at Brown.
- To permit this saving, closed steam coils, rather than direct steam injection as at Brown, will supply heat to reduction reaction. This avoids introducing water to electrolyte at the reduction stage. Furthermore, these steam coils, working in conjunction with a condenser, will serve as an evaporator to concentrate the electrolyte before it recycles from reduction reactors to electrolytic cells.
- Redesigned electrolytic cells will be cheaper to build and install. The design will minimize copper bus work and make it easier to short-circuit cells for maintenance. And, while a selenium rectifier is now used by Brown, future installations will get improved power efficiency with germanium rectifiers.

▶**Changes Already Made** — For all these a-coming flowsheet changes, the Brown plant itself includes major revisions on the European plants.

One key point of difference is in materials of construction. Europeans use a lot of ceramic and stoneware in equipment and piping. While sticking chiefly with steel for its equipment, Brown uses rigid polyvinyl chloride for some 80% of its process piping.

Too, Brown's plant uses more instruments in order to cut down on the need for highly skilled

manpower, more cheaply available in Europe.

"And," Spitzer points out, "we had to choose different auxiliary equipment than the Europeans right down the line. It was a question of picking items that could be installed and maintained under usual American paper mill conditions, which differ quite markedly from European practices." For example, Brown uses steam jets where Europeans use mechanical vacuum pumps.

▶ **Process Details**—Sodium chlorate-sodium chloride solution, recycling from reduction stage, feeds at the rate of 200 gpm. through flash cooler to the cell room.

A bank of 20 parallel-hooked, 4x9x3-ft., 10,000-amp. steel electrolytic cells provide, together with a storage tank, a total electrolyte volume of 16,000 gal. Cells, fitted with graphite anodes and steel cathodes, operate at 105 F. Selenium rectifier applies 3 v. d.c. across each.

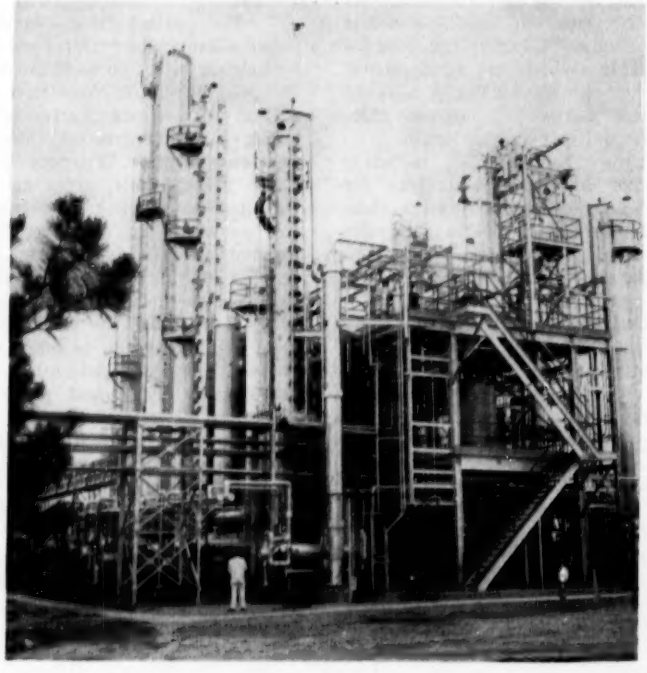
Unlike chlorine-caustic cells, these units don't have diaphragms. Sodium chromate, introduced to the electrolyte, plates out on the cathodes as something of a diaphragm. But its function is to improve current efficiency, which runs around 80%.

Hydrogen produced vents to atmosphere, and the cell liquor, analyzing 400 g./l. $NaClO_3$ and 90 g./l. NaCl, feeds to a storage tank. Liquor then flows through a bag-type filter to remove any graphite flaked from the anodes. A metering pump sends the solution through a cartridge-type filter to the reduction reactors. This filter removes any contaminants that would cause dioxide decomposition.

▶ **Cascade Reduction**—Reactor stage consists of six saran- and brick-lined steel tanks, 4 ft. dia. by 5 ft. high, connected in a cascade series. Filtered cell liquor and 20-deg. Be. HCl feed to the first tank, then cascade down the line. Reaction temperatures vary from 95 F. in No. 1 to 212 F. in the last two, where steam is injected.

Air enters No. 4 reactor and, flowing countercurrently upstream, strips out chlorine and chlorine dioxide from the solution. Exit gas stream, analyzing about 10% Cl_2, 10% ClO_2 and 80% air, goes to a 30-in.-dia., 30-ft.-high packed column, where the ClO_2 is absorbed in water. The resulting 0.5% ClO_2 solution goes to the pulp bleachery; the residual chlorine likewise ends up at the bleachery in the form of sodium hypochlorite.

Consumption per lb. dioxide produced: 5.5 kwh. power; 1.6 lb. HCl; 0.03 lb. graphite; 7.5 lb. steam. About 1 lb. of chlorine is recovered as hypochlorite.



New Plant Makes Commercial Neopentyl Glycol

Designed for several-million-lb./yr. capacity, Texas Eastman's new Longview, Tex., installation makes neopentyl glycol via condensation of isobutyraldehyde and formaldehyde, followed by hydrogenation. Interest in product centers primarily on stable molecular structure.

Solvent Extraction Wins Carbonate-Leach Uranium

Faced with decreasing proportions of low-lime ores coming from the mines, the uranium industry soon may be forced to greater use of carbonate leaching systems. Looking toward that day, A. D. Little, Inc., San Francisco, has produced a solvent extraction system under AEC contract that's believed to be the first to recover uranium from carbonate leach solutions.

At the moment, bench-scale investigation indicates that the new system is not economically competitive with current carbonate leaching systems using yellowcake or diuranate precipitation. But there is a good chance that it could be refined and developed for commercial use when the industry starts to swing over to carbonate leaching.

Little's approach relies on complexing the uranium with 8-hydroxyquinoline to form a

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negative ion with a single charge. Then it is extracted into a suitable organic solvent by a singly charged organic cation

Tetra-alkyl ammonium ions work most effectively. However, only clarified solutions can be processed this way, because ore pulp strongly adsorbs tetra-alkyl ammonium ions.

Another phase of the exploratory work indicates that adsorption of 8-hydroxyquinoline on char enables the char to extract uranium from carbonate solutions or slurries. Also, it may be possible to separate the uranium by floating a precipitate of sodium uranyl quinolinate formed at high pH in the absence of an organic cation solvent. Such a separation would be comparatively simple, since no filtration is required.

Nonshrinkable Wool Is Hope of USDA Project

A new process to make wool nonshrinkable may help the fiber regain its once-strong position in the textile industry.

Developed by Western Utilization Research and Development Div. of the U. S. Department of Agriculture, the method is reportedly a simple one. It involves applying a mixture of polyamide and epoxy resins to the wool's surface layers. The fabric is first conditioned by wetting and drying, then soaked in a water emulsion of polyamide-epoxy mixture. Amount of mixture deposited can be controlled by a wringer-type machine with pressure gages or by a unit similar to a spin dryer.

Though the project is still in the lab stage, cost of resins required is said to be cheap. For a finished woman's sweater, added cost is roughly 5¢.

Researchers are still working to eliminate a slight stiffening in the treated fabric, probing other combinations of resins and various softening agents. USDA looks forward to scaling up lab techniques to pilot-plant and large-scale production in the near future.

Firm Makes Silica Gel Via Continuous Process

Boasting the industry's first continuous-flow silica gel process, newly formed American Industrial Chemical Co. is now turning out a broad range of silica gel, hydrogel and silicates.

One section of the firm's Butler, N. J., plant is devoted to continuous production of large quantities of silicas, and a second section is equipped for specialty formulations.

Although the firm is reluctant to divulge process particulars, available information reveals this about the tail end of the route: Continuous solid-bowl centrifugal separates silica gel from a slurry (presumably silica gel-water); silica gel is dried in a rotary dryer, then goes to bagging operation.

Reactive Metal Process: Purer Metal From Oxides

A simple, low-cost way to produce purer high-melting-point metals has been proposed by Illinois Institute of Technology.

New process, patented (U.S. 2,803,536) by Director of Metallurgical Engineering Lucio Mondolfo, wins titanium, zirconium, chromium, hafnium, niobium or vanadium directly from their oxides. Method involves reacting oxides with aluminum under conditions favorable for complete removal of oxygen.

"Experiments with the new method," says Mondolfo, "yield purer metals than can be obtained by present methods, even after years of development and improvement."

Hot Gases Used Thrice, Process Saves on Fuel

Good fuel economy is Allis-Chalmers' claim for its new process for pelletizing and heat-hardening taconite concentrates. Process is in pilot plant at Carrollville, Wis.

There are four steps: Forming ¼-½-in.-dia. pellets in a balling pan; drying the pellets on a moving grate (above); partially oxidizing them on the grate at 1,800 F.; final hardening in a rotary kiln at 2,400 F.

Hot kiln exit gases are used for heating the pellets on the grate; exhaust gases from this step are used for drying; hot air from cooling the hardened pellets is used as secondary combustion air in the rotary kiln. Over-all fuel consumption, says A-C, is only 750,000 Btu./ton.

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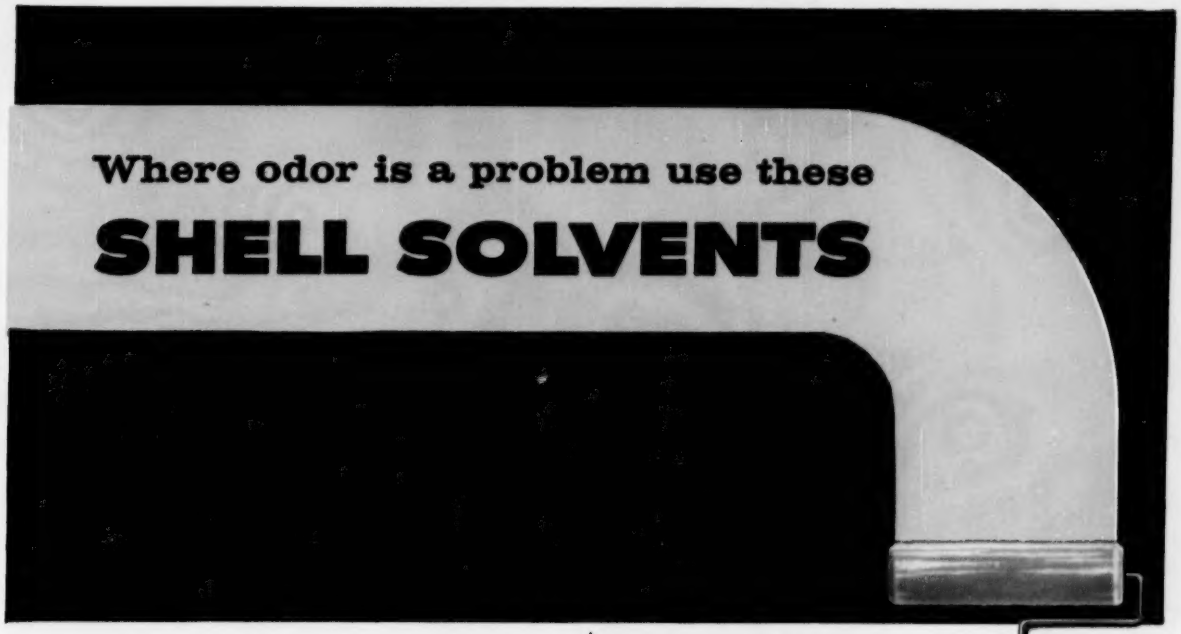

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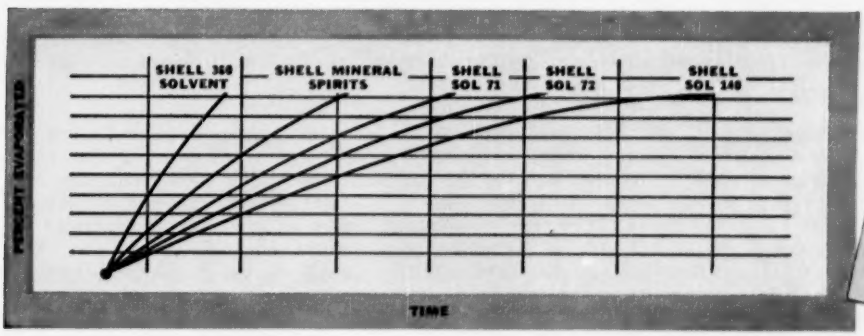
Typical properties of these Shell Solvents are contained in booklet shown. It will be mailed on request.



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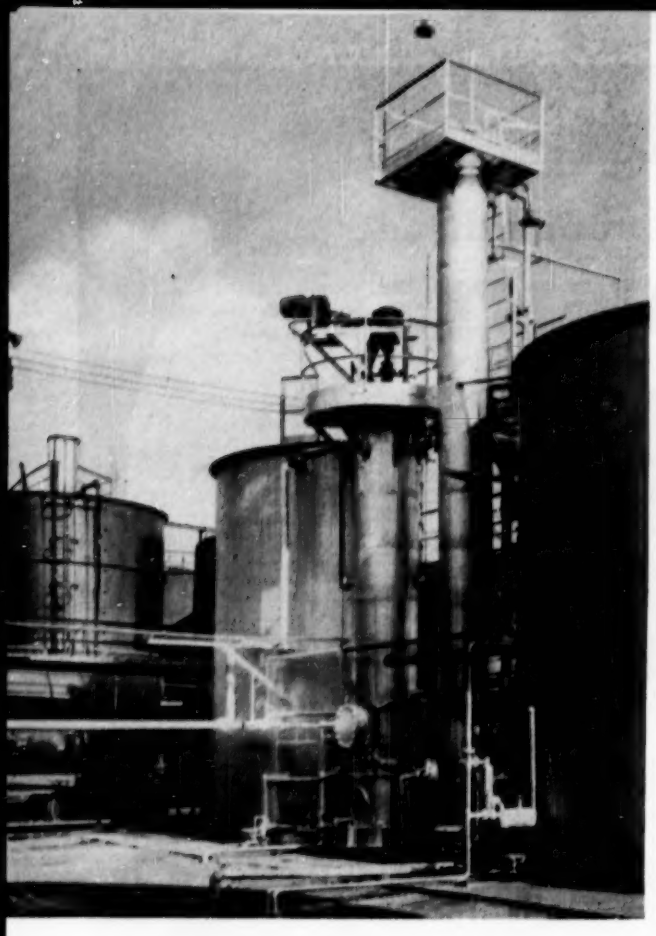
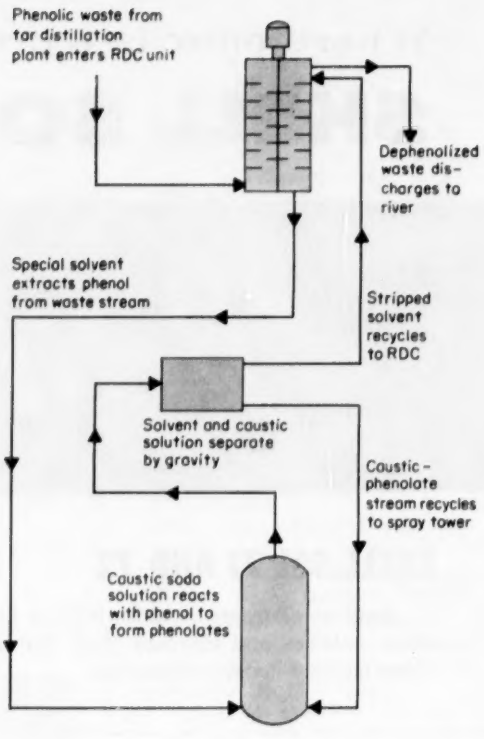
SHELL




Phenolic waste from tar distillation plant enters RDC unit
Dephenolized waste discharges to river
Special solvent extracts phenol from waste stream
Stripped solvent recycles to RDC
Solvent and caustic solution separate by gravity
Caustic-phenolate stream recycles to spray tower
Caustic soda solution reacts with phenol to form phenolates

New Team Licks Phenolic Waste Problem

Chemical and petroleum processors with phenolic waste streams may find winning combination with new aromatic solvent, rotating-disk contactor.

Phenol removal from the waste stream of Allied Chemical & Dye Corp.'s Barrett Div. at Detroit has taken on a new look. Coupling a rotating-disk contactor with a pair of new solvents, Barrett is now using an extraction process which, according to A. N. Heller, supervisor of industrial waste development, is more economical to install and operate than any other process for dephenolizing tar distillation wastes. And it gives more reliable performance, adds Heller.*

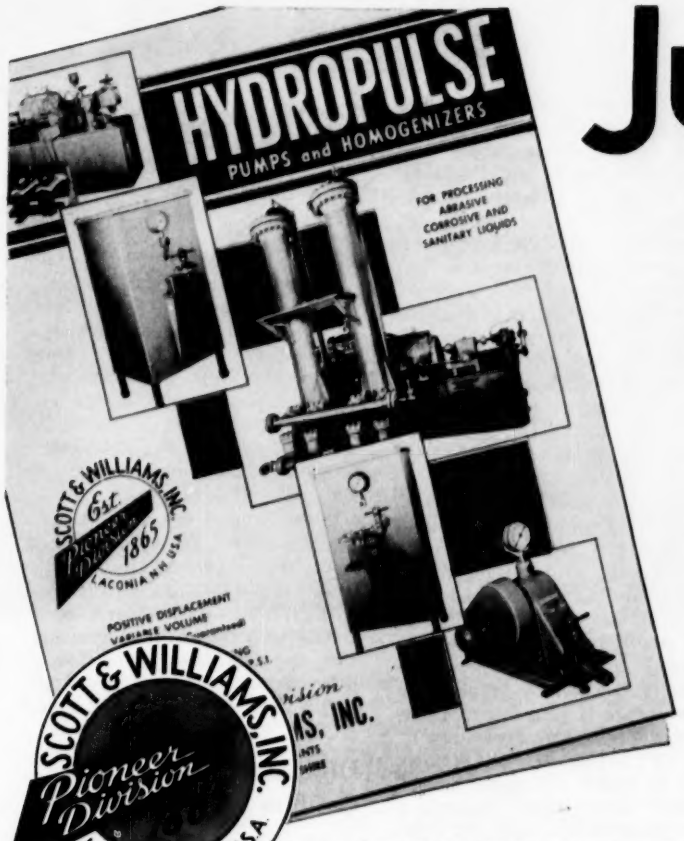
Barrett's new 12,000-gal./day unit (*see photo*) knocks phenol content of waste stream from around 5,000 ppm. down to about 9 ppm. on a continuous basis. Investment in this treatment plant is in the neighborhood of $125,000. (Capital investment for a 100,000-gal./day plant would run around $200,000.)

▶ **Growing Problem**—Treatment of phenolic wastes is growing in importance with increasingly stringent control over waste disposal on the part of public authorities.

Barrett's development came about from a combination of its own needs and the necessity of lowering the phenolics discharge into the Detroit Waterway. Use of a mechanically agitated extraction column not only makes for more efficient dephenolizing but also lowers phenol discharge well below required levels.

▶ **This Pair Wins**—Key to the new process is the solvent. Actually, there are two of them—Solvents "103" and "105." These are heavy aromatic oils, containing a mixture of high-molecular-weight tar bases, and are of specific gravity 1.03 and 1.05 respectively. Equilibrium partition of phenol in these patent-applied-for solvents is very favorable. Distribution coefficient is around 20, much higher than any other dephenolizing solvent now used. Either of the new solvents is used, depending on the condition of the waste being treated. (*Continued*)

* Twelfth Industrial Waste Conference, Purdue Univ., Lafayette, Ind., May 14, 1957.



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Other half of the winning combination is the rotating-disk contactor (RDC), a liquid-liquid contacting device developed several years ago by Shell Development Co. (*Chem. Eng.*, Apr. 1955, pp. 132-134). Internally, RDC has a series of agitators mounted on a central shaft and separated by stator rings or wire packing to form separate contacting stages. This device permits intimate countercurrent contact of two liquids of differing densities while avoiding emulsification of the liquids. Previously used in petroleum refineries and in general chemical applications, this marks the first time RDC has found use in waste treatment.

Barrett's RDC unit is 3 ft. in diameter and has a 12-ft.-high, 24-compartment extraction zone. Heller says that RDC was selected because it was optimum from standpoint of economics and performance when coupled with the new solvents.

▶ **They Work Together**—Here's how the solvent-contactor combination works:

Plant wastes flow directly to a 50,000-gal. collection tank. No pretreatment is necessary, since wastes are "clean," i.e., relatively free from suspended oil and solids. Waste is pumped from the tank to the base of the RDC, where it rises and contacts a descending stream of dispersed solvent. After passing through a short settling zone to separate entrained solvent, dephenolized effluent flows to plant sewer for monitored discharge to Detroit's River Rouge.

Enriched solvent flows to a regenerating spray tower after separation of any entrained waste. Solvent is dispersed into a continuous phase of caustic soda solution, the phenolics reacting to form sodium phenolate. The mixture is sent to a settling tank prior to recycle. Caustic can be recirculated until 90-95% saturated; solution is then drained out for phenolics recovery and the unit recharged with 20-35 wt. % fresh caustic solution.

▶ **Advantages**—For conditions existing at Detroit, Heller cites several benefits gained from Barrett's solvent extraction process:

- Intimate liquid contact yields thorough dephenolizing along with a clean "break" of solvent and waste. At a solvent ratio of 1:1, unit reduces phenol content from around 5,000 ppm. to around 9 ppm. At a ratio of 3:1, phenol content drops as low as 1.6 ppm.
- Plant operation is flexible. Type of solvent, solvent ratio and RDC rotor speed can all be tailored to meet needs of waste being treated. It takes only 15 min. from startup to reach equilibrium conditions.
- Consistent performance is joined with ease of operation.

▶ **Complex Problem**—Treatment of phenolic wastes presents many knotty problems; type of process needed depends on condition of the waste. If appreciable quantities of suspended oil or solids are present, pretreatment is necessary before dephenolizing. If properties of the waste vary greatly from day to day, a dephenolizing process such as steam stripping might be used. Every plant presents a different problem, and it's difficult to compare results.

Koppers Co. at its Follansbee, W. Va., coal tar and tar oil processing plant has a solvent extraction process different from Barrett's. Koppers uses its own solvent in a Koch Kaskade tower, along with waste pretreatment. Koppers' solvent is a light aromatic oil with added tar bases (sp. gr. 0.88, distribution coefficient 5-7).

Many coke-oven plants use a solvent like benzene or other light oils to extract phenol from their wastes.

Barrett itself continues to operate a steam stripper at its Frankford Works in Philadelphia, Pa. And the company finds this unit best to handle the varied conditions there.

How might the new Barrett process work on other phenolic waste streams? It's hard to say. Tar dehydration waste that Barrett handles in its RDC is similar to ammonia liquor byproduct from coke-oven operations. Barrett process works well on this waste but translation to other uses, such as coke-oven, phenol-formaldehyde or petroleum refinery wastes, can only be approximated.

Natural Gas for Fuel And What Else?

Natural gas will soon be supplying fuel needs for Shell Oil Co.'s refinery at Anacortes, Wash. The third refiner in that area to switch to natural gas, Shell has signed a 5-yr. contract with Cascade Natural Gas Corp. Natural gas will replace noncondensable refinery gases and fuel oil previously used as refinery fuel. Results will be greater flexibility in refinery operations, increasing output of fuel oil and lower costs.

Rumored but not confirmed is the report that those West Coast refineries also intend to use natural gas to produce petrochemicals; ammonia has been mentioned as a possibility. Speculation persists that plans for a petrochemicals plant in Anacortes will be announced soon.

Dow Adds Mercury Cells, Doubles KOH Production

Adding a new battery of mercury cells, Dow Chemical Co. has about doubled high-purity caustic potash capacity at its Pittsburg, Calif., plant.

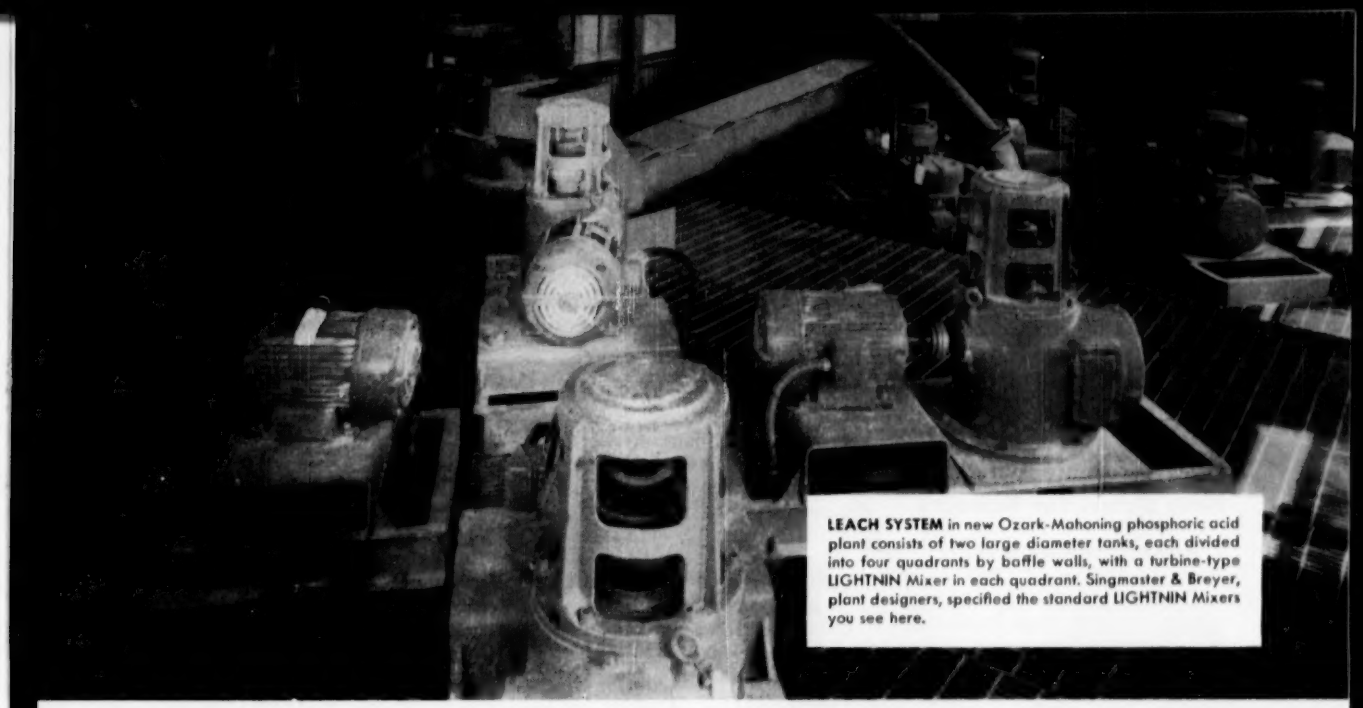
Extra-pure (50%) caustic potash is needed for detergents based on tetrapotassium phosphate instead of tetrasodium phosphate.

Although Dow won't disclose design details of new units, a company spokesman does say that cells are of Dow's own design and that germanium rectifiers will be used. Germanium power rectifiers efficiently supply high amperage in low-voltage range.

Hungarian Petrochemical Combine to Take Shape

Scheduled to be under construction soon, Hungary's Tisza-Videk chemical combine, as plans now stand, will have six factories turning out fertilizers, ammonia, potassium chlorate, acrylonitrile, polyvinyl chloride and basic organic chemicals.

Natural gas from the Rumanian Transylvanian oil fields



LEACH SYSTEM in new Ozark-Mahoning phosphoric acid plant consists of two large diameter tanks, each divided into four quadrants by baffle walls, with a turbine-type LIGHTNIN Mixer in each quadrant. Singmaster & Breyer, plant designers, specified the standard LIGHTNIN Mixers you see here.

New acid process gives **95% yield** *with good mixing in leach tanks*

More often than you might think, *good mixing of fluids* can make the difference between "just average" and superior process results.

That's one reason why LIGHTNIN Mixers were specified for this new wet-process phosphoric acid plant at Ozark-Mahoning Company, Tulsa, Okla. Singmaster & Breyer, New York engineering firm, did the process and equipment design for Ozark-Mahoning Company.

High yield—low cost

Utilizing the Belgian Prayon process, relatively new to this country, the plant consistently yields better than 95% of acid containing 30% P_2O_5. It produces a 32% product from sulfuric acid as weak as 55%.

Leaching temperature is 15-20 degrees cooler than conventional processes—easing the corrosion problem and permitting the use of less costly materials of construction.

The new plant has run without a hitch since the day Ozark-Mahoning operating management pushed the button.

How mixers help

Good mixing does its job in the leach system, where finely ground phosphate rock is slurried with recycled phosphoric acid, then reacted with sulfuric acid to precipitate gypsum.

A LIGHTNIN Mixer in each of eight leach-tank compartments provides the exact balance of fluid flow and turbulence needed for intimate acid contacting and highest extraction values.

The LIGHTNINs also provide complete uniformity and immediate dispersion of reactants, resulting in the growth of large, easily filtered gypsum crystals.

On *your* next project, why take chances on fluid mixing when you can be *sure?* With LIGHTNIN Mixers, you get the security of knowing there's a mixer to match your requirements *exactly*—with replacement parts always quickly available if you ever need them.

Predictable results

You're sure about *results*, too—because your LIGHTNINs are selected on the basis of application and test data unique in industry. Many thousands of pilot runs, plus scientific methods of scale-up, insure predictable mixing results that are unconditionally guaranteed.

For quick, competent help in getting a new process started right, or in making an old process more efficient, call your LIGHTNIN Mixer representative. He's listed in Chemical Engineering Catalog. Or write us direct.

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YOU CAN HANDLE any fluid mixing job, in tanks of any size or shape, with LIGHTNIN Mixers. Results are fully predictable; unconditionally guaranteed.

FOR LATEST MIXING INFORMATION and full description of LIGHTNIN Mixers, send for these helpful bulletins:

- ☐ Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP (B-102)
- ☐ Top entering; propeller types: ¼ to 3 HP (B-103)
- ☐ Portable: ⅛ to 3 HP (B-108)
- ☐ Side entering: 1 to 25 HP (B-104)
- ☐ Laboratory and small-batch production types (B-112)
- ☐ Condensed catalog showing all types (B-109)
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- ☐ Data sheet for figuring mixer requirements (B-107)

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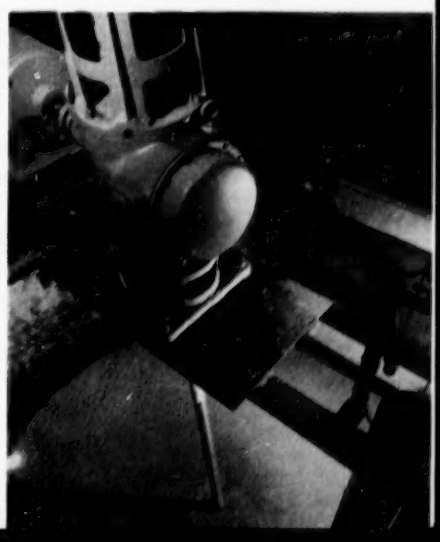

will be used for raw material and some power generation. Pipeline from the fields will be roughly 250 mi. long.

Plans for the combine, drawn up since 1955, call for an operating work force of 4,000 people, of which 2,500 are to be chemists, engineers and technicians. No on-stream date has been announced.

Utah Oil Shale Slated As Next Target for Refiners

Another oil-shale area, in the Bonanza district of Utah's Uintah County,* near the Colorado border, is very likely headed for commercial development. Probable partners: National Farmers Union of Denver, Colo., and Phillips Petroleum Co.

Utah State Land Board, following hearings at Salt Lake City, indicates it's willing to issue a 16,000-acre lease to brothers Ben, Ernest and J. A. Olsen, who, in turn, have an agreement with NFU.

NFU's secretary and general counsel, Charles F. Brannan, says it would launch a research project on mining and retorting shale, would associate with a partner in any commercial venture. Brannan cites NFU's association with Phillips in New Mexico fertilizer ventures as an example.

▶ Has Pipeline Advantage — Significantly, oil shale is near the lines of Salt Lake Pipe Line Co. which bring crude from Rangely and Red Wash fields to Salt Lake refining area. Phillips has a refinery here, at Woods Cross.

Existence of common carriers and markets for retorted shale is a big advantage. Contrast this situation with that of Union Oil Co. of California, which proposes to transport semirefined shale oil from Colorado to southern California.

Unlike Union's deposits near Rifle, Colo., NFU's oil shale lies relatively deep, but there are many outcrops of good-grade shale in canyons. Reportedly, water supply and ash-waste disposal don't present too many problems.

* Same area as American Gilsonite Co.'s gilsonite project. No gilsonite, however, is involved in oil-shale lease.

Hawaii's First Dynamite Plant Is "Push-Button"

In sidestepping dynamite import restrictions, Hawaii will get what's described as the world's first push-button-operated dynamite plant.

Plant will cost $140,000 and will turn out 1 ton/day. Though it will have about 30 workers, machinery operated by remote-control switchboard will mix chemicals with an aggregate of solid materials to make the explosives.

Plant will be built by a combine of Hawaiian construction companies and explosives distributors.

Operations will be located on a 22-acre site near Honolulu.

Convention Calendar

Second World Metallurgical Congress, 39th National Metal Exposition and Congress, Hotels Sherman and Palmer House, Chicago, Ill., Nov. 2-8.

International Congress and Exhibition of Measuring Instruments and Automation, Duesseldorf, Germany, Nov. 2-10.

1957 Tracerlab Oil Symposium, applications of radioactivity in petroleum production, Shamrock Hotel, Houston, Tex., Nov. 6-8.

American Society of Refrigerating Engineers, Shoreland Hotel, Chicago, Ill., Nov. 14-16.

10th Exposition of the Air-Conditioning and Refrigeration Industry, International Amphitheatre, Chicago, Ill., Nov. 18-21.

Chemical Market Research Assn. and Commercial Chemical Development Assn., joint meeting, Houston, Tex., Nov. 20-21.

Manufacturing Chemists' Assn., 7th semiannual meeting and winter conference, Statler Hotel, New York, N. Y., Nov. 26.

26th Exposition of Chemical Industries, Coliseum, New York, N. Y., Dec. 2-6.

Plant designer Gordon Strubler points out that he wants to make this the world's safest; if this plant is successful, Hercules Powder Co. will call on him to build similar ones in Madagascar, Formosa and the Philippines.

Interest High in Routes To Cheaper Fission Power

Keyed to the current economy note, projects in the U.S. and Europe are probing two nuclear reactor fuels in a search for cheaper atomic power.

Researchers at Battelle Memorial Institute have come up with promising results from experiments on a solvent extraction process to make reactor-grade thorium, using countercurrent extraction of aqueous thorium nitrate with a 30-vol.-% solution of tributyl phosphate in Solvesso-100. Over a 26-hr. steady-state test period, their pilot plant turned out roughly 5.5 lb./hr. of high-purity* thorium nitrate, with an over-all recovery of 99.89%.

Britain's Atomic Energy Authority will study thorium as fuel in high-temperature, gas-cooled reactors. Most likely, thorium, along with uranium, will be incorporated into ceramics. Thorium and uranium-233 will breed more U-233. General Electric has been awarded the contract to build a zero-energy experimental reactor for AEA, which, reportedly, will reach temperatures as high as 1,400 F.

Other developments throughout Europe point to plutonium as another hotly researched fuel. Stung by fuel crises during the Suez shutdown and unwilling to depend solely on U.S.-supplied U-235, European countries are pinning high hopes on plutonium. To make their own U-235, they feel, would be just too expensive. And natural-uranium-fueled reactors mean higher capital investment. The alternative, according to rhyming British researchers: the "plute route."

* Meeting AEC specifications, product contained less than 2 parts in 10 million of copper, as little as 2 parts in 1 billion of rare-earth elements.

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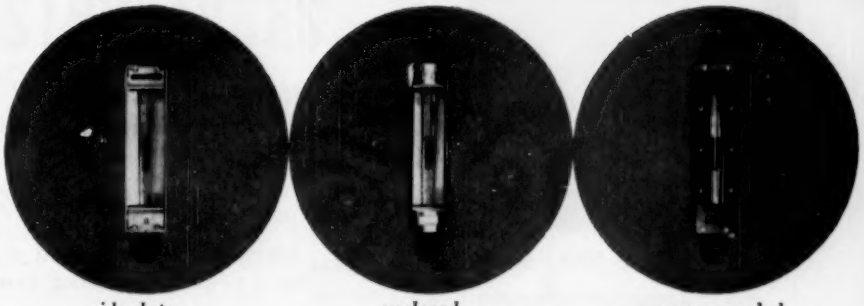

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Rugged general-purpose basic design. For non-hazardous uses.

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Attractive design with stainless bezel; gasketed safety glass cover.

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For use with ball floats to meter low flow rates.

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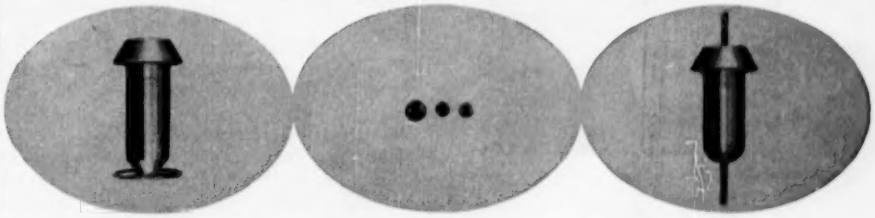

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2 types, 7 sizes for use with bead guide tubes.

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For highly corrosive fluids or specialty applications.

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All 1700 Series Flowrators embody proven engineering principles for measuring any flow accurately up to 200 gpm of water, 400 scfm of air. Pipe connections—horizontal or vertical, screwed or flanged—can be made from any direction through a provision for 360° rotation of connection. Full data on the 1700 Series is given in Catalog 10-A-25. For your copy, write Fischer & Porter Company, 217 County Line Road, Hatboro, Pennsylvania.

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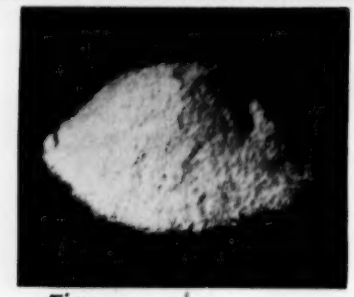

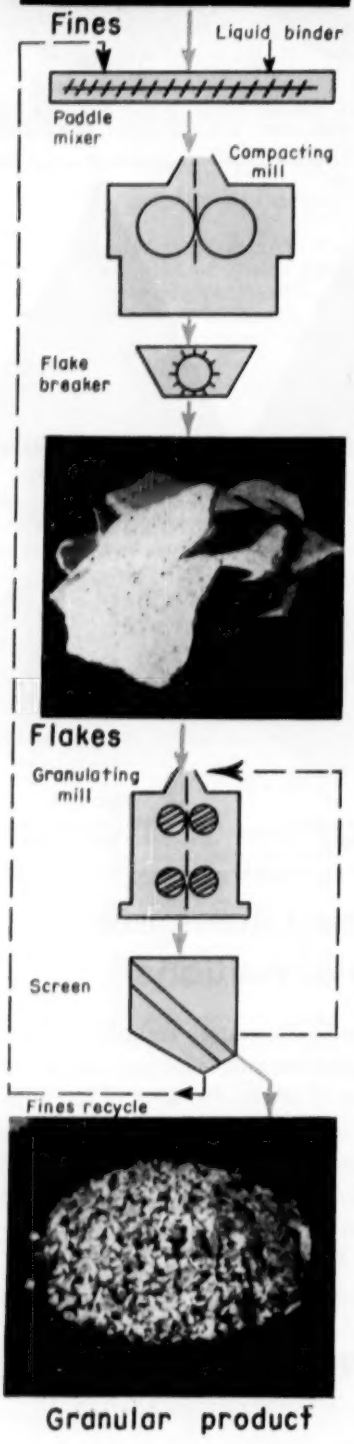

FOR UPGRADING FINES

Granulate by Compacting

Already in successful use on inorganic salts, new process is being groomed for bigger role.

For his unrelenting war on waste and loss, the chemical engineer now has another battle-tested weapon to add to his armory. It's a new mechanical compacting scheme, developed by Allis-Chalmers Mfg. Co. (Milwaukee), that takes off-grade, dusty materials and steps them up in size to eminently marketable products.

Last month Duval Sulphur and Potash Co. completed a highly rewarding year of operating this process at its Carlsbad, N. M., potash plant. With an installation which cost $125,000, Duval now takes 10 tons/hr. of 28-mesh and smaller potash fines, once destined to waste and loss, and recovers 60-70% of it for sales.

First to put the compacting process through its commercial paces, Duval has triggered what A-C happily feels is an unmistakable process trend among inorganic chemical manufacturers. Within this past year three more potash producers, three coke-oven ammonium sulfate plants and makers of diammonium phosphate, sodium nitrite and carbon have added the process to their main production facilities.

▶ **Behind the Trend** — What's behind this bustle of activity? In a word: dust.

One operating headache common to many inorganic salts producers is the unavoidable production of large volumes of finely divided particles. For example, a potash plant may turn up 50-70% of its total output as particles passing 28 Tyler mesh. These fines dust away in handling and packing, cake easily during storage and fly to loss when being applied as solid fertilizer.

A-C's compacting scheme effectively combats these conditions. Fines produced by the main flowsheet are fed to a compacting mill, where they are squeezed into a continuous sheet. This sheet is broken into chunks, then granulated to marketable mesh in a roller mill. A gyratory screen separates out any over- and undersize particles and recycles them.

▶ **Economics Support Trend** — Most obvious attraction of the new process is that it converts a waste or low-value material into a high-quality, money-making product. Duval feels that quality of the product from its compacting process is, if anything, superior to its main-circuit potash.

But, importantly, it does this at a reasonable operating cost. Here's a breakdown on Duval's major running expenses: Power, 6¢/ton of fines processed; labor, 6.7¢; maintenance, 8.9¢.

With commercial success established in the inorganic field, A-C is now focusing its attention on other materials that pose dusting headaches. At its Milwaukee labs A-C has successfully compacted finely divided maleic anhydride, vinyl chloride and other plastics and organics.

▶ **Potash Circuit** — Duval runs its compacting operation as an entirely closed circuit, hooked into the product end of its main potash-making flowsheet.

Dried crystals of 28 mesh or smaller are first screened from the main product stream. These fines, still hot from the dryer (about 240 F.), then feed to a double-paddle mixing conveyor. There, saturated sodium chloride solution is introduced to act as a binder and get a plastic-flowing, 0.5%-moisture-content solids for the compacting mill.

Compactor consists of a set of motor-driven, chilled-iron-alloy rolls, each 20 in. dia. with a 20-in. active face. They squeeze the crystals, under "hundreds of tons" total pressure, into a continuous sheet that discharges into a flake breaker. A belt con-

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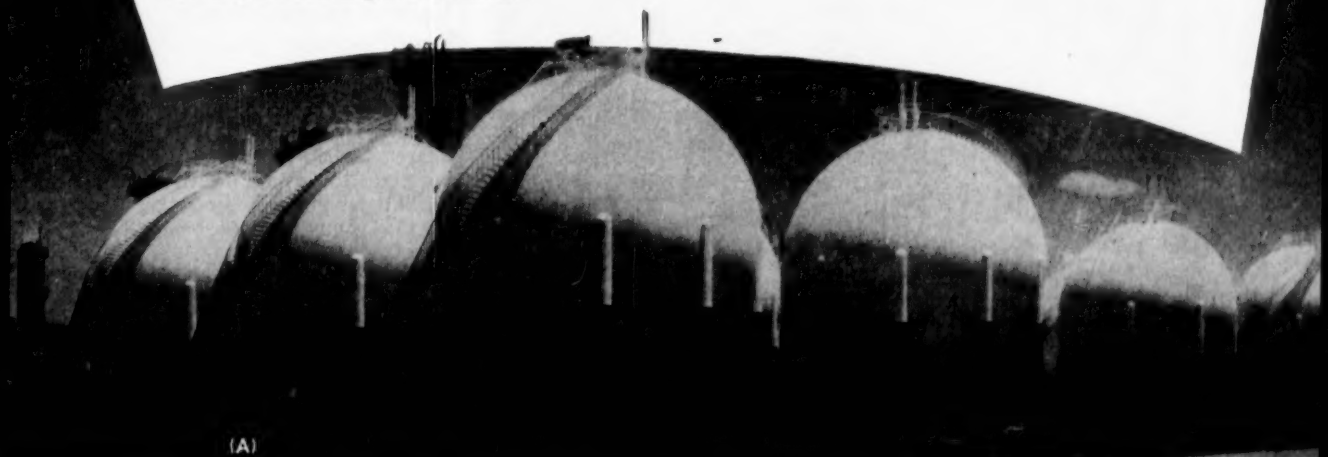

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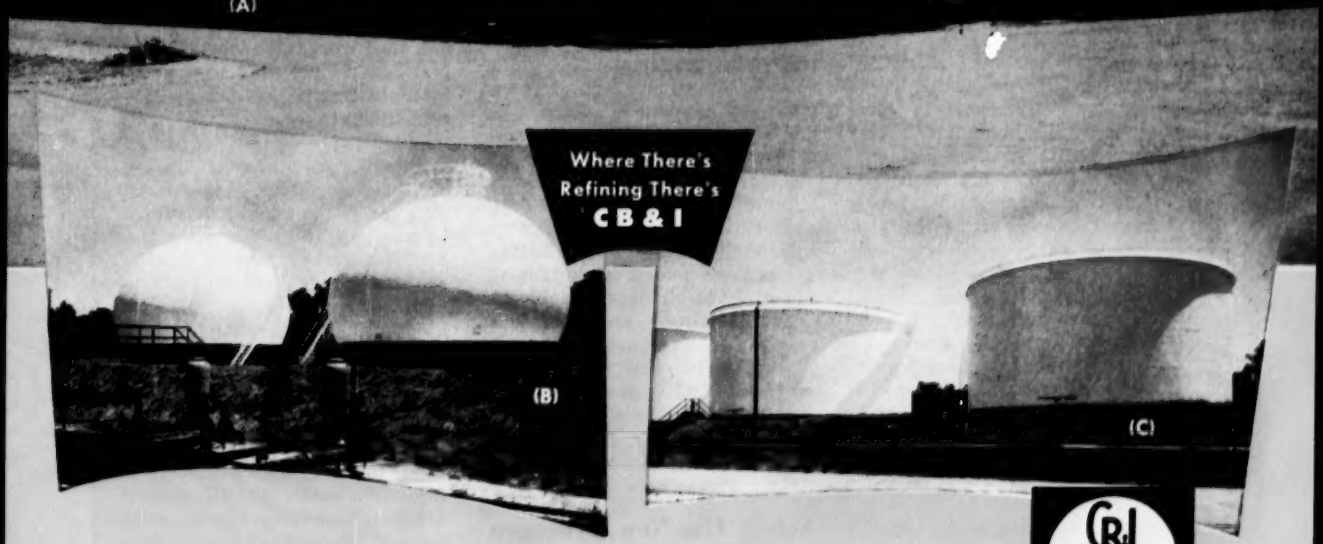

(A) 19 Hortonspheres range in capacity from 2,500 to 12,000 barrels and in pressures from 60 to 130 pounds.

(B) Two Hortonspheroids® storing 5,000 barrels each—are designed for 15 pounds per square inch working pressure.

(C) Horton Double-Deck Floating Roof tanks store aviation gasoline.

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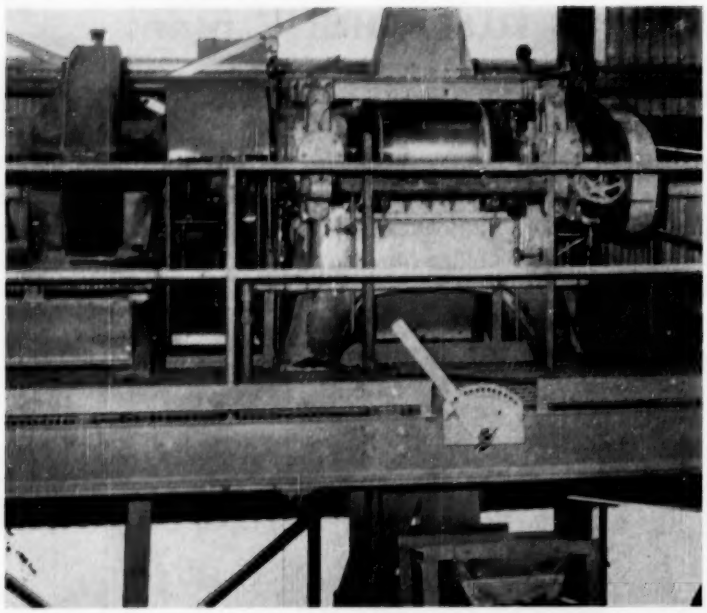


COMPACTOR squeezes potash fines into a solid slab for granulation.

veyor carries the broken pieces produced (about ¾ in. square) to two parallel-hooked granulating mills.

Each mill has two pairs of rolls, 10 in. dia. by 42 in. long. One roll of each pair is corrugated longitudinally, its mate circumferentially. After passing between them, potash granules go to the gyratory screen. Marketed product ranges in size from 6 to 28 mesh. Any oversize returns to the granulator, undersize recycles to the start of the circuit to join fresh fines feed.

▶ **Changes for DAP**—Compacting circuit requires some minor changes when harnessed for diammonium phosphate.

After drying, entire DAP product from main flowsheet—including correct mesh-size crystals—goes directly to the compacting mill. Thus initial screening operation to separate fines and mixing operation to add brine solution are sidestepped. But compacting of this salt requires about twice the roll pressure as does potash.

Final screening of granulated product is adjusted to deliver a crystal size of 6-14 mesh.

▶ **More for Sulfate**—In upgrading crystal size of ammonium sulfate fines, further revisions are required in the compacting procedure.

Crystals from the main flowsheet are not dried. Going directly to the compacting mill from a centrifugal, they have a moisture content of about 2% and are at close to ambient temperature.

After compacting, the ammonium sulfate granules pass to a vibrating-deck dryer for a 5-min. curing cycle. There, heated air reduces moisture content to about 0.1%. This arrangement reduces power and pressure needs of the compactor, produces a harder material that can be more effectively granulated and gets a better over-all yield.

Final screening delivers 8 to 30-mesh crystals for market.

Solvay Has New Hydrogen Peroxide Bleach Process

A new cotton bleaching process has been introduced by Solvay Process Div. of Allied Chemical & Dye. Process cuts bleaching costs, upgrades several important qualities in cotton yarn or cloth, such as brightness retention, absorbency and dyeability.

Distinctive step in the new process is prebleaching with specially prepared hypochlorite after caustic purification, followed, without washing, by bleaching for a shorter period with substantially reduced amount of hydrogen peroxide.

Solvay is now using process in full-scale production, plans to offer it to industry on a royalty-free basis.

Mallory-Sharon Metals Pins Hopes on Process

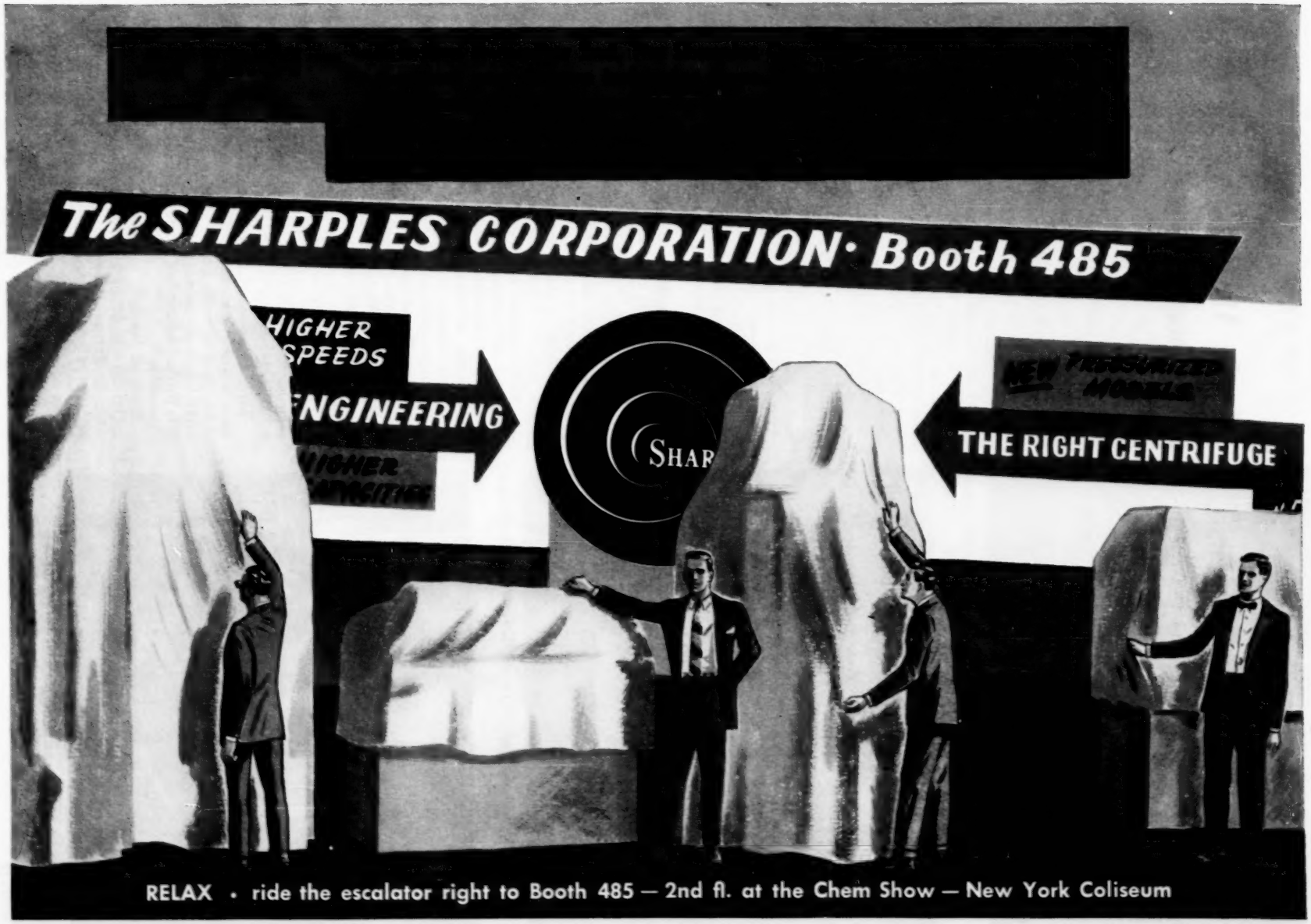
Wielding what it considers the lowest-cost titanium process yet developed, Mallory-Sharon Metals Corp.* is readying plans to forge a position as the largest integrated company in the young reactive metals industry.

When co-owner National Distillers' new plant swings on stream at Ashtabula, Ohio, late this year, the new firm will take over, turning out 10 million lb./yr. of titanium and 2 million lb./yr. of zirconium via National's sodium-reduction process.

This process, according to National's Executive Vice President Robert Hulse, boasts several advantages over the Kroll magnesium-reduction process. Depending on size of operation and the product, investment per annual pound is one-third to one-half that of a comparable Kroll investment. In the sodium process, it's possible to operate with nearly balanced amounts of raw materials, while Kroll process requires a 25% excess of magnesium. Too, sodium-process sponge can be readily leached with water to remove the salt; with the Kroll process, it's customary to include a costly distilling operation to separate excess magnesium and magnesium chloride.

With minor modifications, adds Hulse, sodium process can be used to produce hafnium, columbium and other reactive metals where high purity is called for.

* Formed, in pooling pertinent facilities, by National Distillers, Reactive Metals and Mallory-Sharon Titanium Corp. (with capacity at Niles, Ohio, for 1 million lb./mo. of titanium mill products).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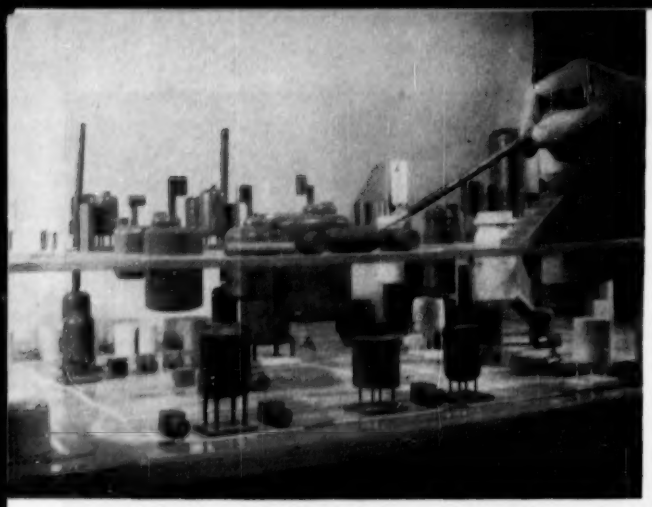
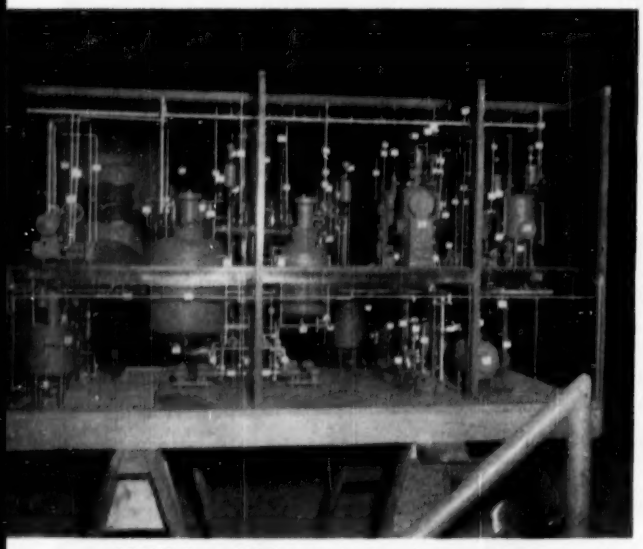
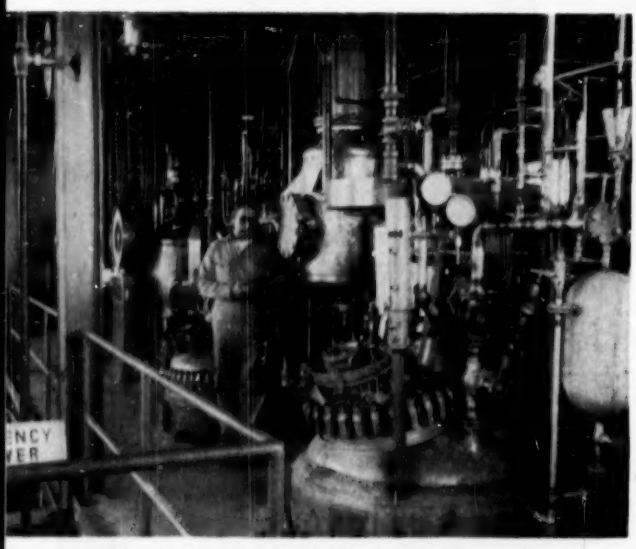
RELAX · ride the escalator right to Booth 485 — 2nd fl. at the Chem Show — New York Coliseum



LAYOUT model led to optimum use of available space.



PIPING model led to faster, lower-cost construction.



RESULTS won acclaim, portend future savings.

Scale Models Bypass Blueprints

Eliminating drawings, Dewey & Almy slashed its engineering time, shaved construction time and cost by 10%.

"Performance above and beyond the call of duty" could be tagged on the new pilot laboratory at Dewey & Almy Chemical Co. (division of W. R. Grace & Co.), Cambridge, Mass. That's because, above and beyond the usual piloting of new processes and products, the polymerization section of this laboratory served as a pilot operation for an engineering model technique during its design and construction phases.

All equipment and piping for this section were laid out entirely by rough sketches, a layout model and a piping model. No engineering piping drawings were ever made or used.

Instead, contractors worked from the piping model to draw up their bids. On the construction site, millwrights and pipefitters worked directly from this model to erect and install all equipment and piping.

▶ **Better All the Way**—On completion of the job, James F. Murphy, assistant chief engineer, reported that:

- Construction of piping model by outside men reduced in-plant engineering time and freed company engineers for other duties.
- Contractor bid firm price, 10% lower than he could have bid from drawings.
- Job reached completion 10% faster. Contractor could plan ahead better, and construction men made fewer mistakes, needed less Dewey & Almy supervision. Number of extras (small items forgotten on original layout) was reduced appreciably.

In addition, the company gained the more conventional benefits of scale models—operator training and optimum three-dimensional layout.

▶ **Drawbacks**—While Murphy is enthusiastic about bypassing drawings with models, he does point out drawbacks.

Piping model is located right at the job site. As pipe and fittings arrive from suppliers, they are color-coded to conform to model. Workmen refer to model as they place each item in position.

While this is ideal for workmen, model always is open to possible damage. Then, since no drawings exist, there is no file record to show how the project originally was planned. (Even drawings often miss this mark, because field changes usually render them inaccurate.)

Much of the risk is removed by photographing the model before moving it to the construction site. Also, in future Dewey & Almy projects, piping mains will be one exception to the no-drawing principle. Their locations will be recorded on drawings and kept on file.

(Continued)

Helping others produce a better product...

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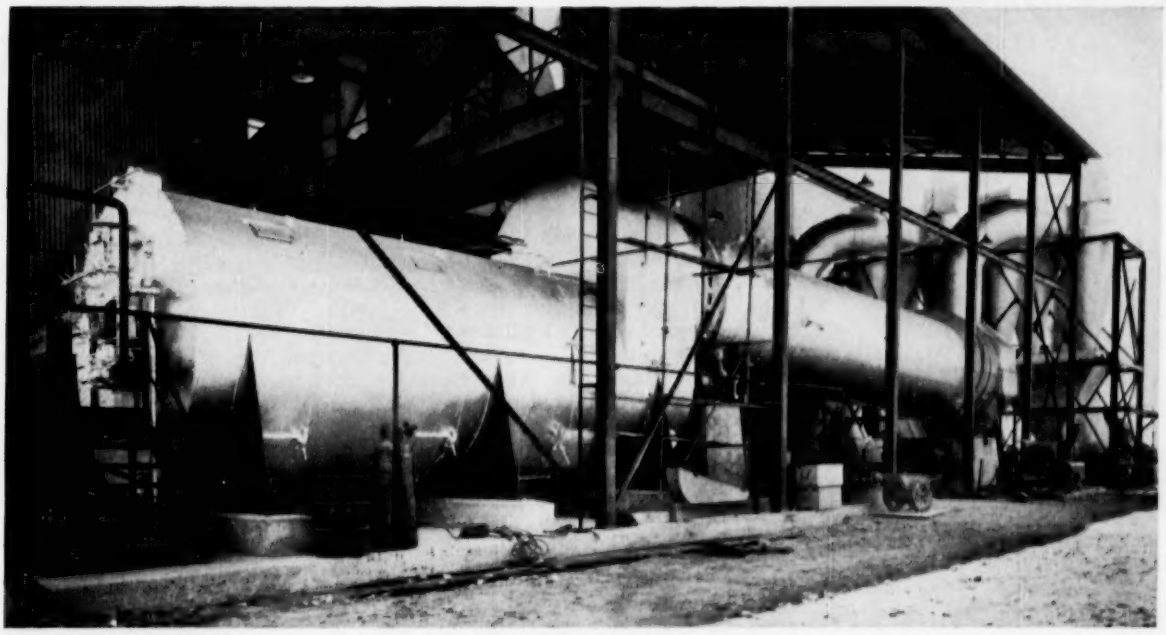

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TO ENRICH THE SOIL FOR GREATER FOOD SUPPLY CALSPRAY'S© NEW PLANT IS ON STREAM... WITH STANDARD-HERSEY DRYERS!

To provide better fruit, vegetables, meats ... and lower farmers' "production" costs, California Spray-Chemical Corporation's new plant is now on stream at Richmond, California, increasing the production of its famous-for-quality ORTHO Fertilizer. With a rated capacity of 300 tons-per-day, Calspray's new plant uses two *job engineered* Standard-Hersey dryers designed and built by the experienced engineers of Standard Steel Corporation ... a world leader in better designs of dryers, granulators, and coolers. Wide range and flexibility are provided to make almost any desired grade of fertilizer.

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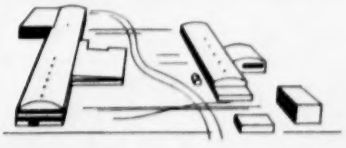

STANDARD STEEL ACQUIRES LEADER IRON WORKS

since Leader 1888

To meet the ever increasing needs of its world-wide customers, Standard Steel Corporation recently purchased the Leader Iron Works at Decatur, Illinois. Founded in 1888, Leader is well known for its work in the food, chemical and petroleum industries. In addition to its customary fabrication, Leader will now manufacture Standard's line of heavy processing and road construction equipment.

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▶ **Balance Sheet**—When Murphy charted out-of-pocket costs for the model method, he found a rosy outlook. Savings on drafting costs and on bid price covered the cost of making the models.

Probing still further into costs, Murphy figured that additional savings, on the order of one to two times the model cost, accrue from reducing extras, supervision and mistakes. And, all-important, the finished unit runs more smoothly because operators can be trained better with aid of the model.

All in all, Dewey & Almy engineers feel that they've sharpened up an engineering technique which will pay dividends in the future.

Zinc Via Blast Furnace Crowns British Efforts

Britain's Imperial Smelting Corp. has finally unwrapped technical details concerning its blast-furnace method for producing prime Western-grade zinc.*

The firm revealed that two pilot furnaces at Avonmouth, with capacities of 30 and 40 tons/day, have turned out over 70,000 tons of zinc. Optimum capacity, Imperial believes, would be about 100 tons/day. Key step in the process is recovery of molten zinc from zinc vapor by shock cooling and scrubbing with molten lead.

What makes the method commercially attractive is its large capacity and its ability to handle high-iron or low-grade ores, recovering such other metals as lead, silver and copper.

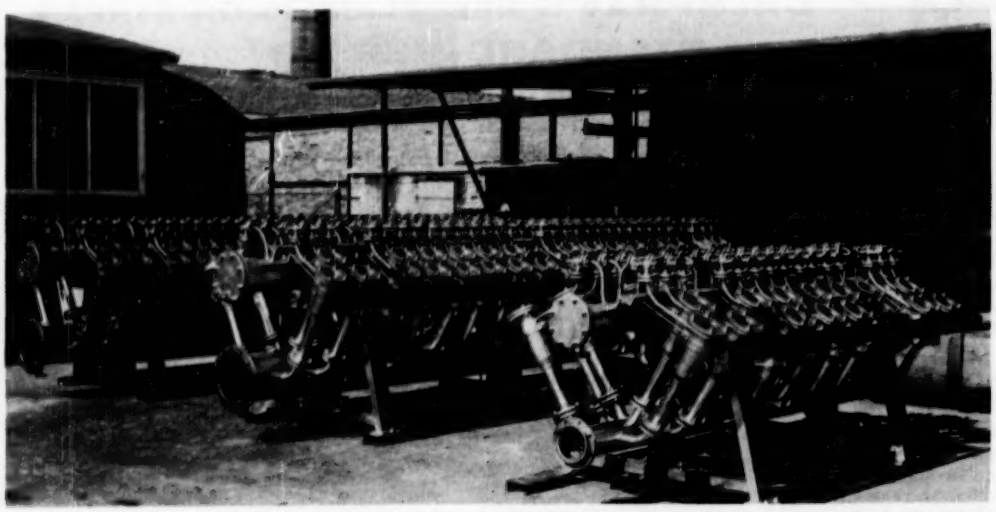
On the other hand, fuel cost may be a deciding factor. Although the now-popular retort method demands a much higher ratio of fuel consumption to zinc produced than does the 1:1 ratio of the blast furnace, coal for retorting is only about one-third as costly as blast-furnace coke.

▶ **Tough Technical Poser**—Spurred by economy to squeeze the last Btu. from the coke, engineers found themselves faced with another problem: Recovering molten zinc from CO_2-rich gas which, given a chance, would convert the zinc right back to its oxide.

The chance it looks for is too low a temperature (below 950 C.). To prevent this, furnace gas is kept hot in passage to the condensers. Molten lead is showered violently by vertically mounted rotors located in the condensers, scrubbing 95% of zinc from the oxidizing medium and further cooling it until it separates from the lead.

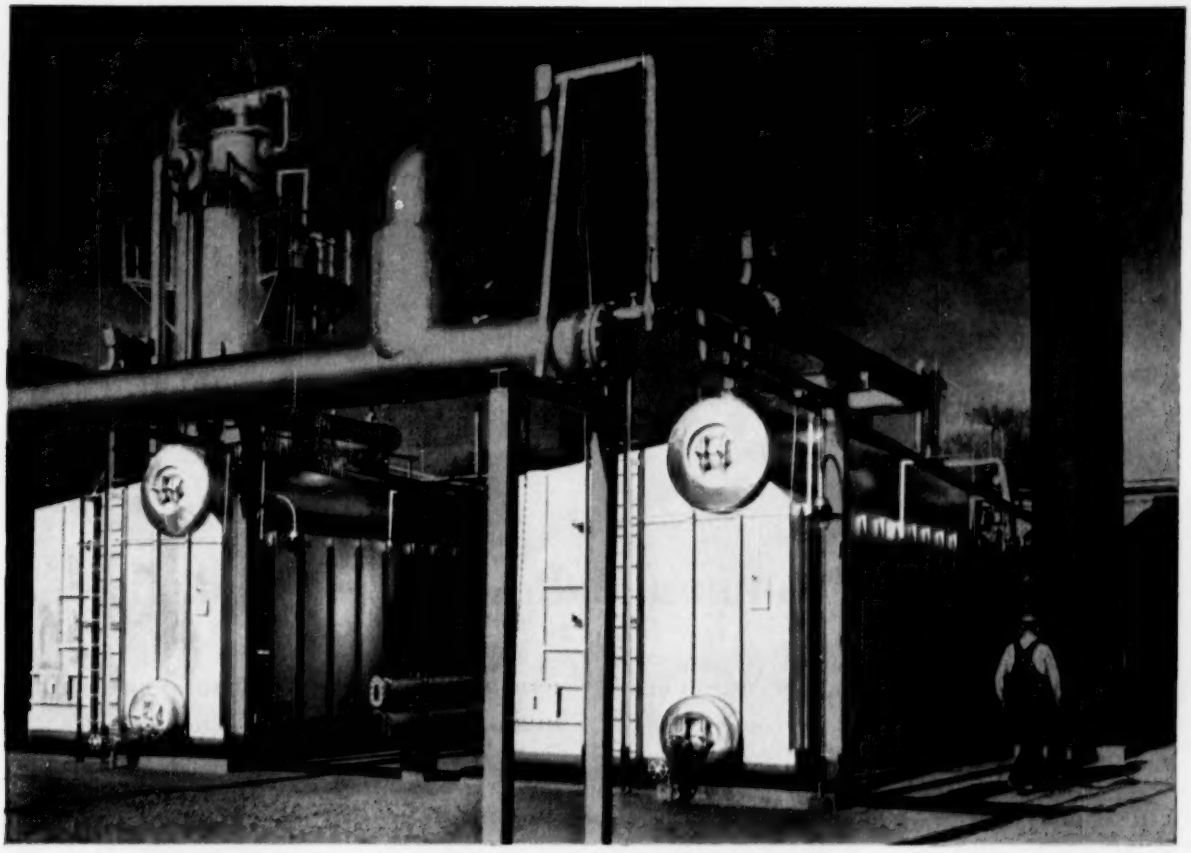
Lead, copper, silver or antimony in the raw material are tapped as matte or bullion and retained in settling tanks; iron is not reduced.

*Assaying, typically: lead, 1.2%; cadmium, 0.07%; iron, 0.024%; arsenic 0.001%.



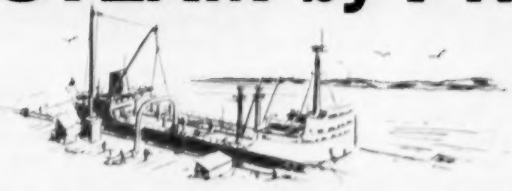
Contact Converters Are Heart of Karl Fischer Formaldehyde Process

When Borden Co. brought in two new formaldehyde plants at Kent, Wash., and Fayetteville, N. C., firm was first in the U. S. to use Karl Fischer process (Chem. Eng., June 1957, p. 147). Picture above shows clear view of converter banks (Borden uses 120 converters at Kent) where methanol is oxidized to formaldehyde over a proprietary silver-type catalyst. German firm of Karl Fischer has been constructing complete formaldehyde plants for over 30 years.



PACKAGED STEAM by FW

helps load more than 7,000,000 gallons of oil in less than 3 months



When U. S. refiners recently were required to meet a sudden, extended demand from Europe for oil, one of the key points of supply was the Magpetco Terminal of Magnolia Petroleum Company. With storage capacity for some 4½ million bbl of petroleum products, this southeastern Texas tank farm was a "natural" for emergency use as a crude oil outlet point – 7,000,000 gallons of crude oil were loaded in less than 3 months.

The two Foster Wheeler Packaged Steam Generators shown above not only met all the normal load requirements but demonstrated ample reserve capacity for emergencies. They provided a reliable source of steam which was essential to operate the many large reciprocating pumps and to heat heavier oil in the storage tanks to facilitate pumping.

Chosen by Magnolia engineers to replace outmoded steam equipment at the terminal, the units are installed outdoors. Casings are of all steel welded construction with weatherproof insulation over the drum ends. Each unit delivers 30,000 lb of steam per hour at 150 psi. Dimensions are: 10′ x 28½′ x 12′ high.

FW Packaged Steam Generators are available in capacities from 10,000 to 62,500 lb/hr and pressures to 1300 psi. For complete information, send for Bulletin No. PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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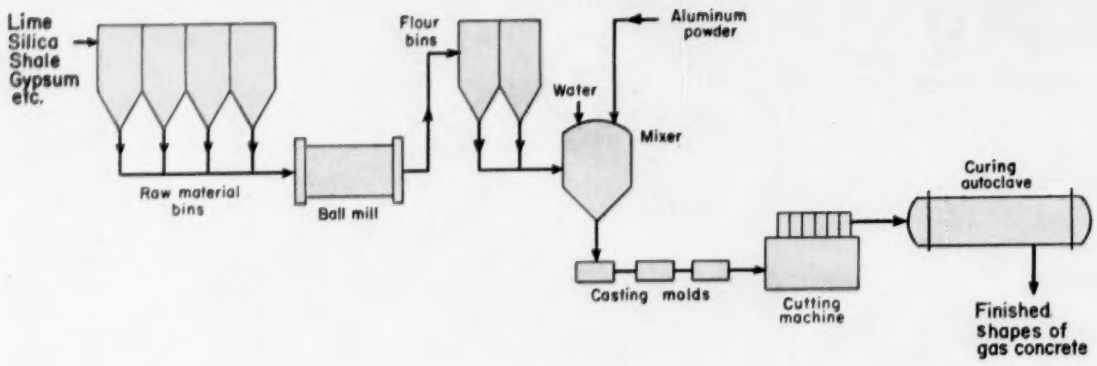

Powdered Aluminum Makes Concrete Foam

Chemical generation of hydrogen gives rise to a new structural material and, concurrently, to a promising new branch of the ceramics industry.

Gas concrete—an unusual new construction material you'll be hearing more about—has made its commercial U. S. debut in the figure of two similar, but vigorously competitive, cousins from Sweden. And, unlike the traditionally demure debutante, this one's come out flying.

• In August, United States Durox Co., licensed by Durox Co. of Sweden through Swedish-American Industries, swung on stream a $750,000 plant at Englewood (near Denver), Colo., to produce 200 cu. yd./day of Durox structural blocks.

• Earlier in the year, Washington Ytong Corp., licensed by International Ytong of Sweden through American Ytong Syndicate, brought into operation a 150-cu. yd./day installation at Tacoma, Wash., turning out a similar product called Ytong.

Both plants plan to double, then triple their output in the near future.

And these represent just the opening guns in high-powered North American campaigns. Two years ago American Ytong Syndicate franchised a 200-cu. yd./day facility at Calgary, Alta., run by Alberta Ytong Mfg. Co. Now its capacity will be doubled. And another plant is under construction at Vancouver, B. C. Swedish-American Industries has granted licenses for 200-cu. yd./day Durox plants at Minneapolis, San Francisco, Dallas and Miami, Fla.

► **Leavening the Trend**—What's spurring this activity? A look at the basic process, and the product that it turns out, underscores the reasons.

Ytong starts with a mixture of a siliceous material (e.g., silica sand), lime and water. Durox also includes cement and gypsum. Both add aluminum powder to serve as a leavening agent for their concrete dough.

Lime reacts exothermally with water to produce calcium hydroxide, $Ca(OH)_2$, in the now alkaline (pH 12.6) mass, reacts with aluminum to form $3CaO \cdot Al_2O_3$ and hydrogen. Evolution of H_2, with its generation of tiny gas bubbles, forces the mass to rise into a lightweight cellular structure. Air drying sets it into a stiff mud; subsequent curing with high-pressure steam converts most of the mass into calcium hydrosilicates.

Final product, then, consists of some 75-85% air cells totally enclosed by thin, high-strength calcium hydrosilicate walls.

► **Attractive Properties** — As a result, gas concrete offers a slate of attractive properties for construction applications. Here's a rundown, according to its manufacturer, on Durox (Ytong's properties are closely parallel):

• Durox weight is only 20-50% that of comparable building materials. For example, the heaviest variety has a density of 1,215 lb./cu. yd. (lightest: 675 lb./cu. yd.), while density of concrete is about 3,800, face brick 3,250 and cinder aggregate 2,700 lb./cu. yd. Yet Durox is manufactured to withstand compressive loads, without reinforcement, of 250-1,100 psi.

• Durox couples the working characteristics of wood and brick. It can be sawed, nailed, bored and hewed with usual carpenter's tools. And it can be chipped, plastered and cemented with mortar, like brick.

• It's fire resistant (an 8-in. wall being considered entirely fireproof), water resistant, soundproof and a good insulating material. And, between −58 F. and 212 F., Durox changes size a negligible 0.000004 in./in.

► **At Low Cost** — Moreover, to top this list off, gas concrete comes to market as a competitively priced material. A 4x8x16-in. structural block sells for about 15¢.

Chief reason is that the raw materials needed are inexpen-

AT THE CHEM SHOW IN N. Y.

You've probably heard about the revolutionary P-K "Twin-Shell" Liquid-Solids blender. But unless you've actually seen this unique blending concept in action, you cannot believe how effectively it can do everything from standard blending, to intensive mixing, to intimately blending liquids—from minute quantities, up to 40% by weight—into solids in one fast step. And this is exactly what you will see in P-K Booths 188-215 at The 26th Exposition of the Chemical Industry Chemical Show in the New York Coliseum, December 2-6!

Whether you want more data on P-K Blenders—or are just an interested spectator at the show, we cordially invite you to drop in at our booths and witness the dramatic example of fast, easy efficient blending that is possible with the radically different P-K "Twin-Shell" blender.

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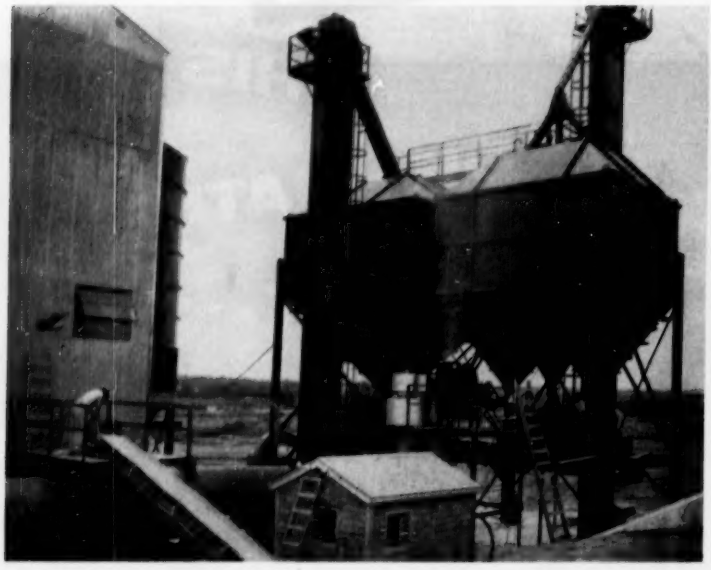
16Q



BATCHING of Durox ingredients begins here; Al powder is added later.

sive. For example, siliceous material can be sand, mill tailings from mining operations or fly ash from power plants. Alumina can be introduced as blast-furnace slag, into which aluminum powder has been added as a foaming agent.

▶ **Proved in Service** — Neither U.S. Durox nor Washington Ytong need rely only on potentialities to justify their active optimism. For gas concrete has already tallied an impressive commercialization record in Sweden.

According to U.S. Durox, 60% of all residential and 50% of all other types of construction in Sweden employ Durox. And American Ytong Syndicate points out that in lumber-rich Sweden, lumber in house construction has dropped from 85 to 14% since World War II, thanks to the arrival of gas concrete on the market. Furthermore, both products are made and marketed in more than 10 other countries. Well over 1 million cu. yd. of Durox and 2 million cu. yd. of Ytong are produced world-wide, annually.

Biggest difference between U.S. operations and those in other countries is in the product shapes made. In Europe, blocks are predominant; in U.S., panels, prefab wall units and glueable stave units will be chief shapes.

▶ **How Ytong's Made** — At Alberta Ytong's Calgary plant, the basic raw materials are high-silica shale from company's own mine, locally purchased unslaked lump lime and aluminum powder. Shale is screened for oversize particles that are then cycled through a slugger mill. Correct-size shale passes through a 6-ft.-dia. by 35-ft.-long, gas-fired rotary dryer.

From storage bins, shale and lime are dry ground together in a 6-ft.-dia. by 12-ft.-long ball mill to the fineness of cement (190 mesh). Then they are further blended by air jets and agitators in a silo. Now a flour-like material, the mixture is weighed into a 1.5-cu. yd. mixer specially designed by International Ytong. Aluminum powder and water are added and mixed intensively there for about 3 min.

Mixer then discharges into 4-ft. by 8-ft. by 18-in.-deep open molds. Each mold is filled to about half its volume, and hydrogen generation swells the mass to fill the mold. These molds, mounted on wheels, are electrically driven along a track from the mixer to the curing area. This operation takes about 2 hr., in which time the mass fully rises and sets.

▶ **Cutting and Curing** — Four sides of the mold then are opened, and a hydraulically driven, stainless-steel-wire cutting machine cuts the casting to the desired size. At Calgary, 12-in. by 18-in. by 2- to 14-in.-thick slabs are made.

Molds then go to a battery of three 84-in.-dia. by 74-ft.-long autoclaves, each able to hold 16 molds. There, a 15-20-hr. steam-curing period completes the setting of the gas concrete. Saturated steam at 120-180 psi. (175-190 C.), provided by a 11,000-lb./hr. package steam plant, is used for the job. From the autoclaves, the molds are unloaded and the Ytong is ready for market.

Belgian's Efforts Augur Continuous-Flow Titanium

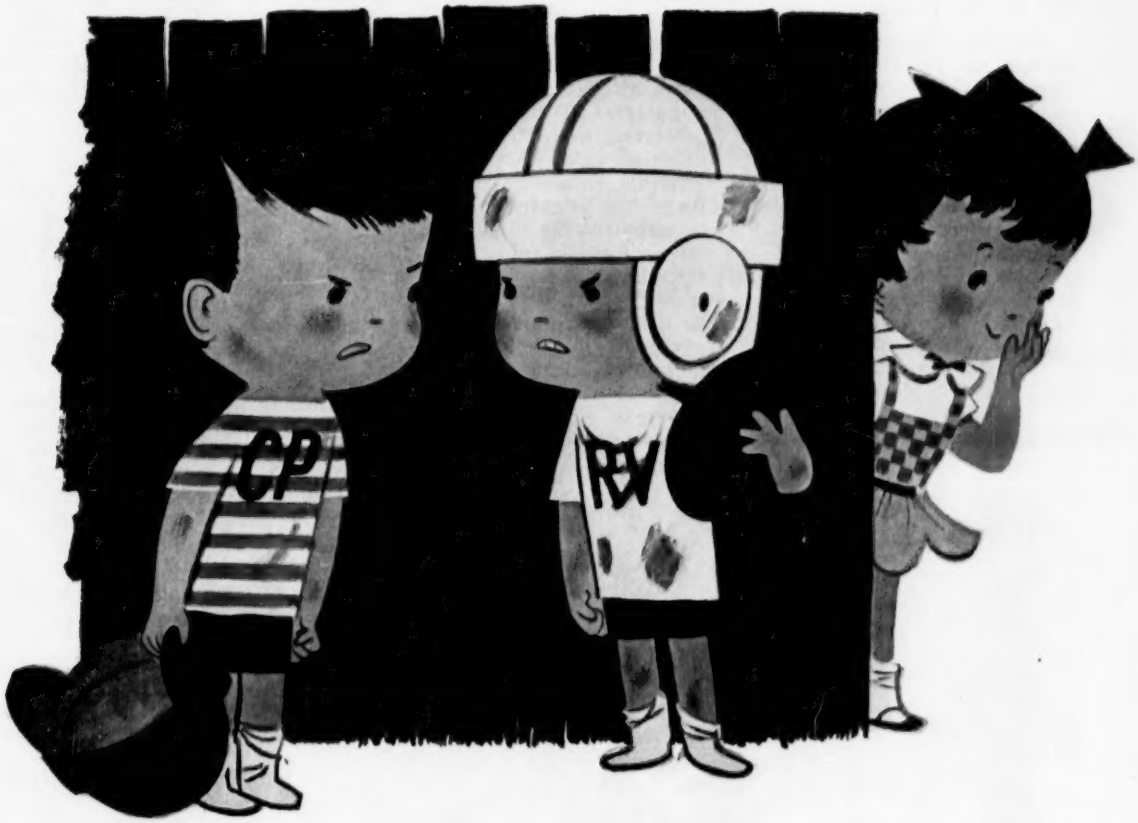
Secretively, in his private laboratory in Ghost Alley, on the fringes of the port of Antwerp, a young researcher works intently to perfect his discovery.

No mad scientist, however, Leo Thyssens, 29, has the backing of a Belgian bank, typically pound-and-penny-wise, and awaits the verdict of Belgian steel industry on his newly developed continuous process for making titanium and titanium alloys.

Engineer Thyssens claims that his process can lead to the recovery of both titanium and iron from ilmenite, an ore cheaper than the rutile generally used now. Moreover, the process can turn out pure titanium or a predetermined alloy, depending on the charge to the "reactor"—or latter—stage of the process.

In the early stages the process follows established lines: Titanium is separated from iron in the ore and converted to the tetrachloride. From tetrachloride to metal (the "reactor" stage—details still under wraps), the process is continuous and automatic. Cost estimates of ore-to-metal processing of titanium by this method are pegged around $1.35/lb. (present market price of titanium sponge: $2.25/lb.). This cost estimate is based on a 200-ton/yr. production figure.

USCOLITE PLASTIC PIPE



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Both Uscolite RV and Uscolite CP have been carefully engineered to solve particular corrosion problems. Our technical men will help you select which is better for the service conditions involved.

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British Probe H-Bomb For Power Potential

Controlled thermonuclear reactions to provide industrial power are one step closer to reality. An apparatus built as a joint effort of United Kingdom Atomic Energy Authority and British industrial firms has just been completed at Harwell and will be used to conduct fusion experiments.

Apparatus will operate in conjunction with a Harwell technique for heating hydrogen isotopes to several million degrees C. At these temperatures, the hydrogen nuclei fuse and give out tremendous energy. A "very large" electric current supplies the heat and generates a magnetic field which focuses hot gases away from walls of the container. At ultra-high temperatures involved, walls would vaporize on contact with gas. External magnetic coils are thought to be answer to problem of turbulent gas slipping out of inner magnetic field. Trick the scientists now have to work out is how to sustain fusion reaction so that energy release exceeds energy input.

Indications are that British device is similar to one planned for Forrestal Research Center at Princeton University. Called the Stellarator, American device won't be in operation until late 1960 or 1961.

Reformer Reactors Have Bearings, Will Travel

This spherical reactor is one of three for General Petroleum Corp.'s catalytic reformer at Torrance, Calif. Vessels, each 20 ft. high and weighing 100,000 lb., will be set on roller bearings to allow travel when attendant piping expands.

News Briefs

Linear polyethylene: Dow Chemical Co. will build a multimillion-dollar high-density polyethylene plant at Bay City, Mich. Plant is scheduled for completion in October 1958. Plant will use Ziegler process.

Refinery: Commerce Oil Refining Corp. will build a 43,000-bbl./day refinery at Jamestown, R. I. Fluor Corp. will engineer the $50-million job.

Boron: Borax Consolidated is now manufacturing 99-99.7% pure elemental boron in the United Kingdom.

Polio serum: Sera factory of Lublin, Poland, will produce polio serum recently developed in that country.

High-purity silicon: Merck & Co. is slating a new plant for manufacturing transistor-grade silicon. Merck plans production for early 1958.

Vinyl acetate: Air Reduction Chemical Co. will boost capacity of its Calvert City, Ky., vinyl acetate plant from 30 million to 45 million lb./yr.

Orlon: Du Pont of Canada is now producing Orlon acrylic fiber at its $8-million plant at Maitland, Ont.

Anti-Pollutant: Ford Motor Co.'s anti-smog researchers have come up with a vanadium pentoxide powder which, during 100-hr. tests, eliminated 80% of unburned hydrocarbons in exhaust smoke from single-cylinder engine.

Polycarbonate resin: New semiworks for General Electric's Lexan resin is near completion, designed by Crawford & Russell, Stamford, Conn.

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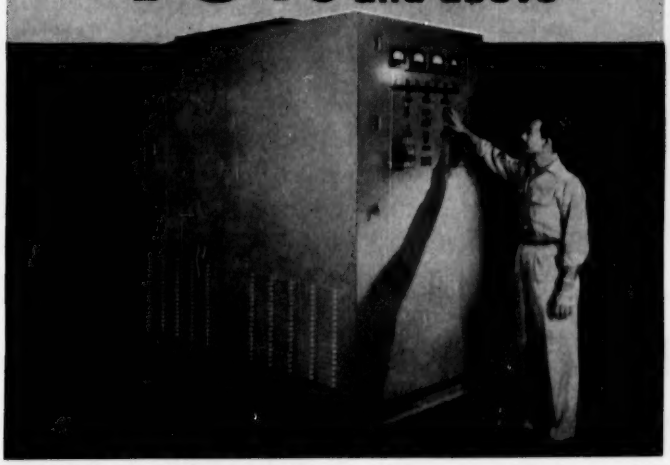

1200 KW Installation consisting of 6 of these units installed at a Government Atomic Energy Facility.

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Aluminum, Titanium, etc. Reduction Manufacture of Chlorine, Magnesium, Hydrogen Sodium, etc. Electrolytic Refining of Zinc, Copper, etc.

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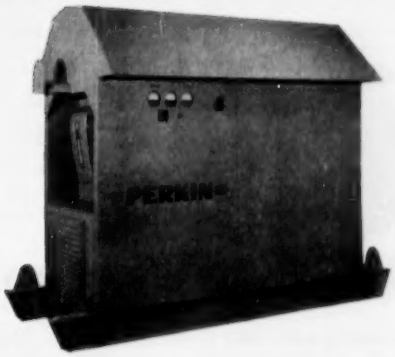

Typical Perkin 100 KW Germanium Rectifier Unit.

PERKIN GERMANIUM and SILICON METALLIC RECTIFIER UNITS have proven to be ideally suited for heavy duty chemical processing applications because of their extremely high efficiencies for low as well as high voltage service, and for their negligible maintenance. There are no special mounting foundations or vacuum pumping facilities required. The units are vibration and noise-free. Also, due to the complete absence of tubes, low ageing and long life characteristics of the rectifiers, and the rugged, conservative design employed, PERKIN METALLIC RECTIFIERS require virtually no maintenance or attendance. The initial installation, plus the long term operation costs are lower than other methods of producing DC power.

In addition to the applications listed, many new chemical processing installations for electrolytic production of hydrogen peroxide, the chlorates and perchlorates, and manganese dioxides are going to PERKIN METALLIC RECTIFIERS in lieu of M-G sets, mercury-arc, or mechanical rectifiers as a result of the above and many other advantageous features.

For operation of heavy duty DC motors, PERKIN has standard 25, 50, 100, 200 and 300 KW METALLIC RECTIFIER UNITS available.

We would be pleased to send you further complete data upon receipt of your letterhead inquiry. Send your specifications for our prompt analysis and recommendations.

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Corrosioneering News

As soon as you enter the Chem Show, you'll see the new "R" Series Glassed-Steel Reactor. Going down the line you'll see the Wiped-Film Evaporator, Heat Exchanger, Titan Centrifuge, Conical Dryer-Blender.

You'll see it first at the Chem Show . .

As soon as you enter the Chem Show you'll see looming above the floor the most advanced reactor design in more than twenty years.

It's one of the new "R" Series of Pfaudler glassed-steel reactors, today's most nearly perfect answer to processing with corrosives.

Come up on our observation platform and study the top head. Note the symmetry of the right and left halves of the top head. On this 1000-gallon reactor there are three *four-inch* nozzles on each half, each at the same angle to a centered eight-inch nozzle and an enlarged 30% manhole measuring 14 by 18 inches.

Neater Installations. Symmetrical heads make for easier, faster, and much more flexible installations . . . particularly when you use tandem hookups. A common pipe, for example, can feed two side-by-side reactors with short, straight lengths. Neater installation, more head room; less piping, too.

We put a special glass on the flange faces of the nozzles, so you can get *lapped* surfaces which permit plumb nozzle connections without time-consuming gasket shimming. These truer gasket facings result in safer operation at *higher* pressures and reduce dangerous seepage which could corrode tank exterior.

Compact Agitator Drive. The new "BH" drive is pedestal-mounted. No cumbersome, space-consuming tripod. The drive takes either seal or stuffing box which can be interchanged at your plant in minutes as single "Pfaudlerpac" unit *without disrupting the drive alignment.*

Higher Jacket Velocity. Reduced jacket clearance permits higher velocity and increased heat transfer.

A new jacket sealer vent is located right on the knuckle radius. Here it gives you almost complete exhaust of entrapped jacket vapors. The vent has a 3000-pound series coupling that takes a lot more punishment than the previous light-gauge coupling.

Drainage. Two more things, before you go downstairs. Look *straight down* through the manhole and you'll see the bottom head outlet. We put it off-center so that it's directly in the sweep path of the agitator. Gives you faster, more complete drainage.

The baffle holder is redesigned, too. New method of support gives larger bearing area and more latitude in adjustments. You can get either fingertip or beaver tail baffles.

Bottom Head Improvements. Lots of changes on the bottom head, too. Notice, for example, there are two three-inch clean-out ports for manual inspection and cleaning. One-and-a-half-inch reducing plates take them down to your pipe connection size. The diaphragm area is all stainless steel for better corrosion resistance.

There's lots more that's new in the exhibit, including these special items:

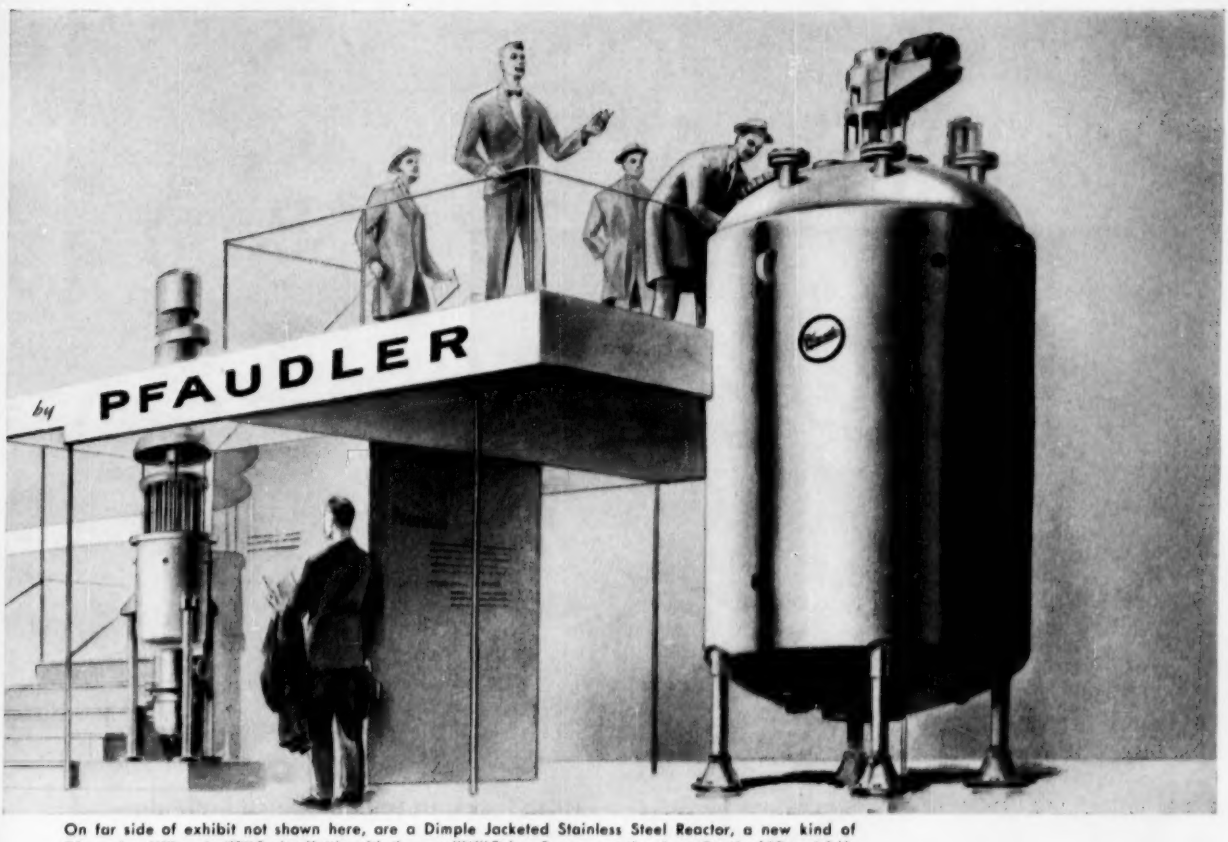
WIPED-FILM EVAPORATOR

We've lifted the top head of this so that you can see its unique features. The floating carbon blades acted upon by centrifugal force, spread your distillands into very thin, uniform films. These films are wiped over the peripheral evaporating surface. They evaporate quickly because of the high heat transfer rate before they can be damaged through thermal decomposition.

FIXED TUBE HEAT EXCHANGER

You can get a heat exchanger like this delivered to your plant *in just two weeks* from your order date. The tubes are 316 stainless. The shell is carbon steel. Capacities are 56, 104, 149, 216, and 316 square feet.

Even with larger sizes you can get four-to-six-week delivery, since we



On far side of exhibit not shown here, are a Dimple Jacketed Stainless Steel Reactor, a new kind of Dispersion Mill and a "P" Series Kettle with the new "W" Drive. See you at the show, Booths 110 and 141.

. . a completely new "R" Series reactor

stock the various component parts.

There's a lot more information on our flexible standard and custom designs in a bulletin which you can sign up for before you leave.

TITAN CENTRIFUGE

You can operate this centrifuge for as long as a month without shutting down for cleaning. It periodically desludges itself *automatically* while running at top speed.

Just for demonstration purposes, we're feeding a green mixture to the machine. You can see the lighter weight component come out as a clear, yellow liquid, and the heavier component as a clear, blue liquid. Push the button we've provided and watch the centrifuge desludge itself in less than 10 seconds.

This centrifuge works exactly the same with slurries running *up to 35% solids by volume*. It concentrates solids up to 40% dry weight while producing clear effluents. Costs less to run, too.

CONICAL DRYER-BLENDER

This is a glassed steel unit that dries and blends materials simultaneously. One of our customers reports that he cut his drying time from four days to *seven hours* with one of these machines.

Look through the transparent outlet plate and you can see the blending action. The white and red chips inside ride up the side of the drum as it revolves and then cascade down into a homogeneous blend. Notice how much surface area is exposed by this action.

During actual operation the drum is under vacuum, so that liberated vapors are quickly pumped away.

Since the unit is glassed steel you can work with all the acids except hydrofluoric and any alkali below pH 12. Working capacities run up to 165 cubic feet.

PUC MULTISTAGE DISPERSION MILL

Here's a completely new and improved way for wet milling and grinding, homogenizing, dispersing, emulsifying, and extracting.

The mill serves as its own pump, drawing material down through a multistage grinding area to preset sizes and then ejecting the product in either batch or continuous runs. With the pumping action, the mill actually cleans itself. Gives you faster, lower cost production, finer particle sizes, and more stable mixes. Capacities from 44 to 6060 pounds per hour.

If, unfortunately, you aren't attending the show, you can get the literature by checking and sending the coupon below.

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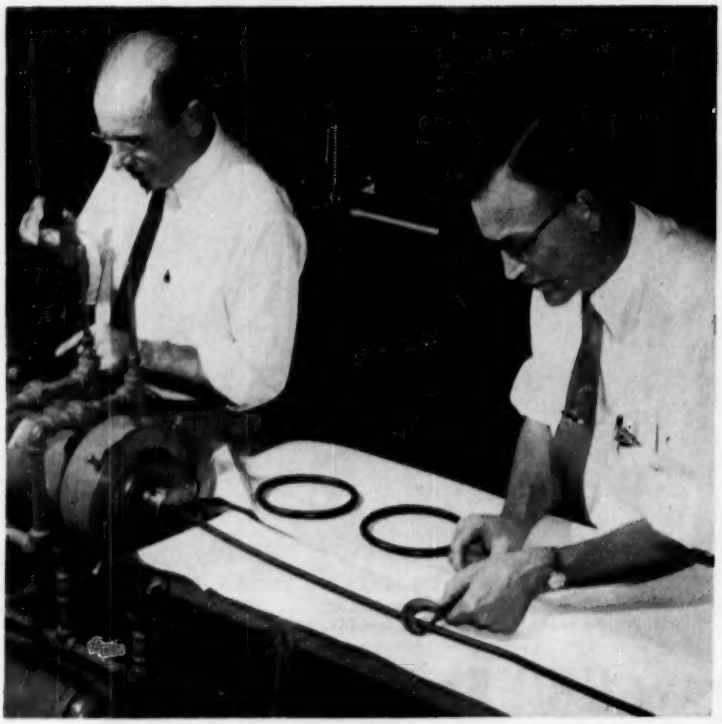

OIL RESISTANT O-rings are made from new urethane rubber.

New urethane outwore other rubbers three to one in tests in which both abrasion and oil resistance were important features.

New Urethane Rubber Accents Durability

A new polyester-based polyurethane rubber is said to be completely oil and ozone resistant, storable indefinitely without deterioration.

Called Genthane S, it is made in pilot plant quantities at General Tire & Rubber Co.'s Mogadore, Ohio, plant, can be put into volume production as soon as demand warrants it.

The new compound shows its best aging properties at elevated temperatures. Rubbery at temperatures as low as −40 F., it does not become brittle at −100 F. and will not crystallize, making it a superior product for use in sub-zero arctic climes and in the frigid upper atmosphere regions.

Other claims made for the new rubber:

- Capable of outwearing any known rubber.
- Superior resilience and abrasion resistance.
- It can be processed on standard rubber machinery unlike other polyurethanes.
- Stable and non-scorching, it eliminates handling problems.
- It has excellent adhesion to synthetic fibers and metals.

Immediate uses for Genthane are expected in valves, gaskets, oil hose, O-rings, oil seals, pumps, wire and cable insulating covers, vibration absorbers, lightweight shoe soling.

A large quantity of the new material has been turned over to the company's tire development division where tests are currently in progress to determine suitability for tire use.

Development of Genthane follows closely on that of the company's Polyfoam, a polyether-based urethane foam, also said to be notable for durability.

Convinced that the new compound is "a foam product superior in most applications to other types of urethane and latex foams at a very competitive price," General Tire has discontinued production of conventional polyester-based urethane foams,* is in volume production of Polyfoam at its Marion, Ind., plant.

Designed for use as a cushioning material and sound and thermal insulator, Polyfoam is

* In general, polyethers are cheaper raw materials than polyesters. Hydrolysis, a problem to users of polyester foams is eliminated in the polyether type.

J-M 85% Magnesia offers excellent workability, ease of application, accurate temperature control.

Make your next maintenance job less costly...yet measurably more effective...with Johns-Manville 85% Magnesia!

At temperatures to 600F, no insulation is so widely used, or so closely associated with economy and increased operating efficiency as 85% Magnesia. Any wonder, then, that 71% of insulation maintenance engineers responding in a recent survey made 85% Magnesia their first choice in its temperature range.

There's good reason for this overwhelming acceptance. In petroleum maintenance, for example, the material's durability, low conductivity, and structural strength are particularly advantageous in both initial application and during operation.

Lightweight and readily workable, J-M 85% Magnesia assures fast, easy application. In operation it provides the ultimate in insulating value—long life—virtually no replacement—and the very minimum of maintenance.

To assure you maximum value in insulation application, Johns-Manville offers you complete planning and job-site service . . . practical recommendations by the world's most experienced insulation engineers . . . plus expert installation by Johns-Manville Insulation Contractors.

Write today for further information on Johns-Manville 85% Magnesia Insulation. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, 565 Lakeshore Road East, Port Credit, Ontario.

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Newsworthy chemicals this month

New urethane rubber accents durability..170A
Antioxidant is non-staining, non-toxic....172A
New line of alkylating agents.....172B
Adhesive tightly bonds rubber to metal...172C
Modifier ups PVC impact strength.....174A
Antifreeze helps paint resist freeze-thaw..174B
Quick, clear dispersant for paint.....174C
Long-wearing asphalt roofing.....174D
PVA makes quick-dissolving packaging...176A
Highly active desulfurization catalyst....176B
Plasticizer helps vinyls resist humidity...176C
Phosphoric acid stabilizes soil.....178A
High strength adhesive for Dacron.....178B
Saran lacquer coating for polyethylene...178C
Two high strength titanium alloys.....178D
Lead-filled epoxy casting compound.....178E
New aldehyde, alcohol in pilot quantity...178F
Silicone vulcanizes at room temperature..178G
Rubber stands wide temperature range...178H
Polyolefin for large-part molding.....178I
Inhibits rust dust in aviation fuels.....178J
Textile softener for cellulosics.....178K

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said to have high tensile strength, greater resilience, far better cushioning qualities than other type foam products, a high degree of compatibility with other materials. It is less than half the weight of natural latex foam. — **General Tire & Rubber Co., Akron, Ohio. 170A**

Antioxidant

Low-melting, non-staining product affords high-temperature protection.

The low melting range of new Catalin antioxidant AC-6 facilitates its incorporation into products such as polyethylene, petroleum hydrocarbons, rubber, impact grades of polystyrene, waxes and other materials in which high temperatures are a factor in processing and in end use.

Chemically, it is 2,2′ thiobis (4-methyl-6-tertiary butyl phenol).

It exhibits outstanding non-staining and non-discoloring properties. The low toxicity of AC-6 suggests its possible use in stabilization of edible and inedible fats and also oils of vegetable and animal origin, as well as its use in stabilizing animal and poultry feeds containing such fats.

It is available in pilot plant quantities. — **Catalin Corp. of America, One Park Ave., New York 16, N. Y. 172A**

Alkylating Agents

New line of alkyl esters of paratoluene-sulfonic acid.

Fine Organics, Inc. is now adding a line of alkylating agents to its organic chemical products list. These are the alkyl esters of paratolunesulfonic acid, known as the alkyl tosylates. Except for the lower members of the series (methyl, ethyl, propyl and butyl tosylates), these compounds have been hitherto commercially unavailable.

The alkyl tosylates enter readily into most substitution reactions. They are generally more reactive than the corresponding alkyl iodides. By their use reactions involving the introduction of an alkyl group into an organic molecule may be run at substantially lower temperatures than those necessary when alkyl halides are used.

The alkyl tosylates will be marketed at a price in line with that of the corresponding alkyl halides.—**Fine Organics, Inc., 211 East 19th St., New York, N. Y. 172B**

For More Information . . .

about any item in this department, circle its code number on the

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postcard inside the back cover

Adhesive

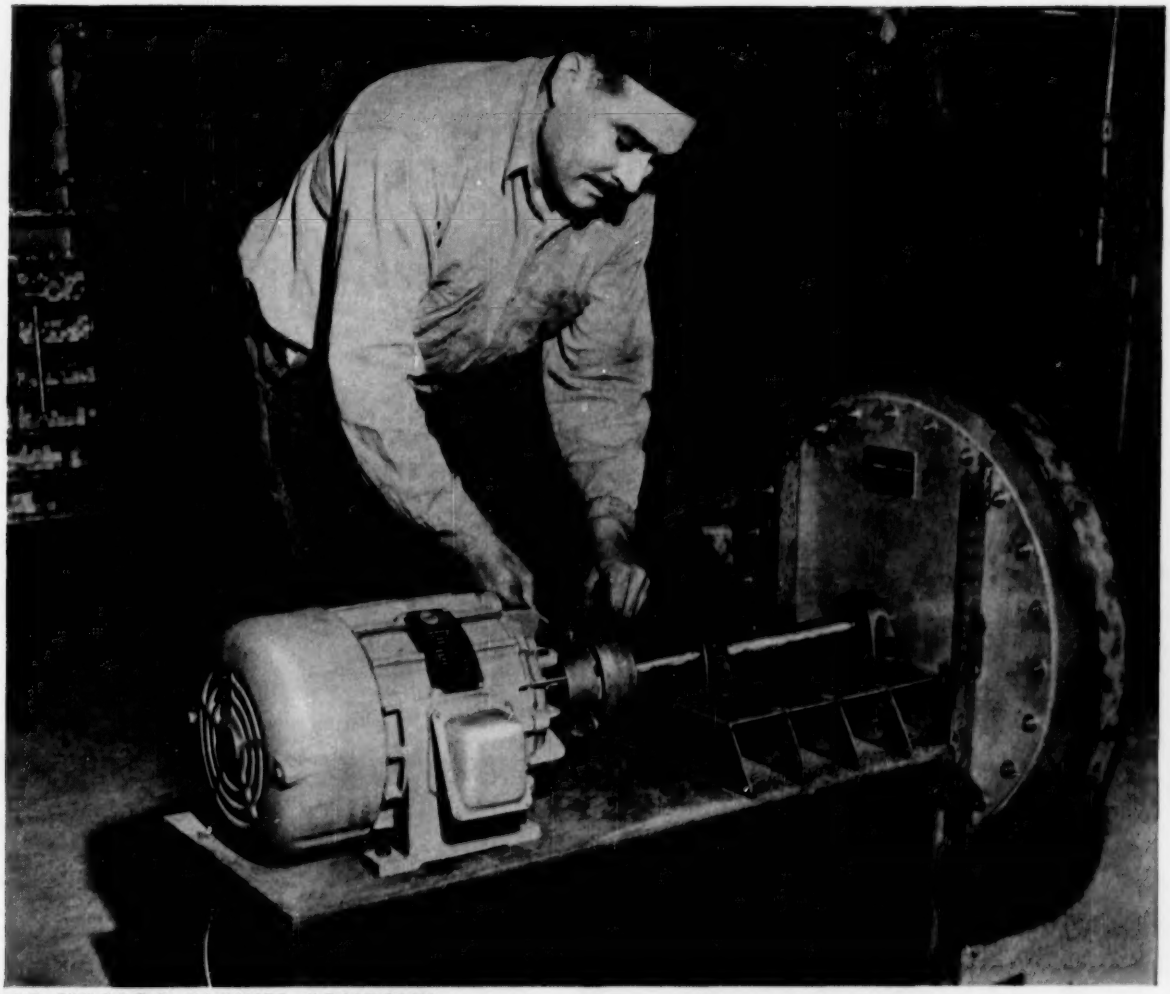
Holds rubber valve liners in place during operation for tight shut-off.

A new adhesive for bonding cured natural or synthetic rubber to metal provides a bond so strong that the rubber will tear before it can be peeled from the metal.

One company uses the compound for bonding a renewable rubber liner to the inside circumference of the bodies of butterfly valves. The diameters of the valves are from 12 to 72 inches. This new adhesive gives a sufficiently tight seal, in conjunction with segments, to hold the rubber liner in place during operation for tight shut-off.

The new adhesive is designated as Ray-Bond R-86001. Cured in 24 hr. at room temperature, it reaches maximum strength after seven days. To reach maximum strength immediately, it may be cured in four hours at 120 to 140 F.

Seven-day immersion tests in 10% hydrochloric acid, 3% sulfuric acid, 10% ammonium hydroxide or 10% sodium hydroxide have shown no visible effect



AT CHICAGO BLOWER COMPANY

DIEHL motors increase product acceptance

To back up their reputation for first-quality design and workmanship in the manufacture of heating ventilating, air-conditioning and exhaust systems, Chicago Blower Company Chicago, Ill., relies on top-flight manufacturers for certain equipment components

"Insofar as the all-important power drive is concerned", says Chicago Blower's President, Fred H. Gohl," . . . we feel we are giving our customers the very best when we give them a DIEHL motor."

In more than ten years of DIEHL motor use, Mr. Gohl knows of no instance in which there has been a failure. And he is enthusiastic about the nationwide chain of DIEHL authorized service stations which are never farther away than the nearest telephone if maintenance or repairs should be needed. These two factors, he says, have definitely contributed to the increased acceptance of their products and explains why Chicago Blower is a consistent user of DIEHL motors.

This is another example of how a forward-looking manufacturer turned to DIEHL for help in building equipment of superior design and performance. With almost three-quarters of a century of experience in producing better motors for varied classes of industry, DIEHL will gladly help you meet *your* motor needs. We will work closely with you to provide the right motor—at the right time—at the right price.

Diehl

DIEHL MANUFACTURING COMPANY
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THE SINGER MANUFACTURING COMPANY
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on the bond. Rubber linings under peel or shear stress can be bonded with Ray-Bond R-86001 for use in temperatures up to 100 F. Dielectric strength is 400 to 450 v./mm.—**Raybestos-Manhattan, Inc., Bridgeport 2, Conn.** 172C

Modifier for PVC

Improves impact strength, higher distortion temperature.

A new acrylic resin modifier, called Acryloid KM-220, improves properties of rigid and semi-rigid vinyl chloride polymers and copolymers which are processed by calendering or extrusion. By improving the processing characteristics and physical properties of PVC formulations, this acrylic modifier is said to permit use of lower cost vinyl chloride polymers as starting materials.

Laboratory evaluations show that vinyl formulations modified with Acryloid KM-220 have the following advantageous properties: improved impact strength; higher distortion temperature; good processing characteristics at reduced temperatures; improved stability to light and heat; higher electrical resistance; excellent vacuum forming properties.

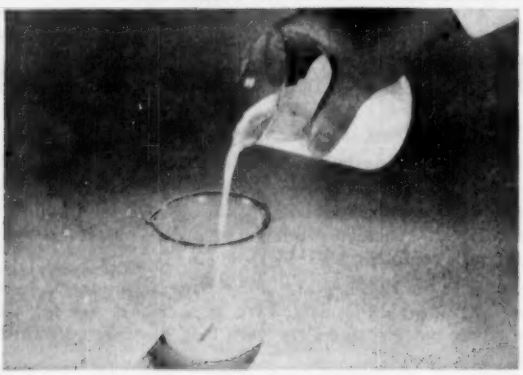
The tests showed that impact resistance increases with increasing percentages of Acryloid KM-220 in the vinyl formulation. It was found also that shorter milling times and lower milling temperatures for a given proportion of modifier produced higher impact strength.—**Rohm & Haas Co., Washington Sq., Philadelphia, Pa.** 174A

Asphalt Roofing

Lasts twice as long as conventional product.

A new cold process asphalt roofing may permanently end the problem of covering concrete tilt-up buildings with raw slab roofs.

Asphalt contains small amounts of metallic materials among which is vanadium. Under certain conditions, these



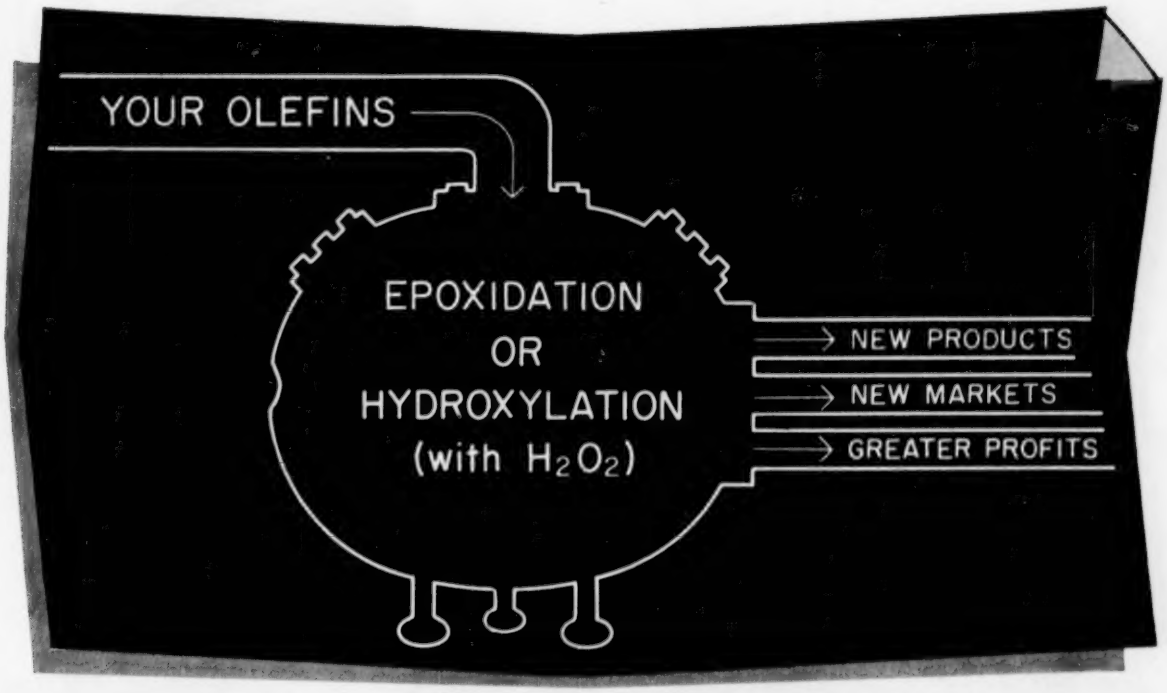
Paint Additives Eliminate Storage and Processing Problems

Anti-freeze

Small quantities of new chemical additive, Armeen S2, kept paint on right, above, from becoming unworkable mass, left, after four cycles of freezing and thawing. A formulated alkaline metal salt of N-coco beta amino butyric acid, it should eliminate winter shipping and storage problems.—Armour & Co., Chicago. 174B

Dispersant

Quick action of new clear, colorless dispersing agent designed for the paint and paper industries is shown above. A 10% solution of the agent, called Daxad 30, is mixed for one minute in a blender with heavy titanium dioxide paste; result is highly fluid dispersion.—Dewey & Almy Chemical Co., Cambridge, Mass. 174C



Blueprint for upgrading olefins with

SOLVAY HYDROGEN PEROXIDE

Epoxidation or hydroxylation by means of SOLVAY Hydrogen Peroxide offers olefin processors a method of upgrading their products into higher profit items for new markets.

Typical higher profit products now being successfully produced by olefin epoxidation or hydroxylation are resin plasticizers, glycols, stabilizers, insecticides, polymers, lubricants, waxes, surfactants, brake fluids. Olefins commonly used in these processes include soya bean oil, cottonseed oil, tall oil, turpentine, linseed oil, unsaturated petroleum derivatives.

SOLVAY®

Aluminum Chloride • Chloroform • Soda Ash
Vinyl Chloride • Calcium Chloride • Chlorine
Potassium Carbonate • Sodium Nitrite • Cleaning
Compounds • Caustic Potash • Snowflake® Crystals
Sodium Bicarbonate • Caustic Soda • Methyl Chloride
Ammonium Chloride • Methylene Chloride • Ammonium Bicarbonate
Monochlorobenzene • Para-dichlorobenzene • Ortho-dichlorobenzene
Carbon Tetrachloride • Hydrogen Peroxide

New Booklet Available

Write for this new review and bibliography on epoxidation and hydroxylation with SOLVAY Hydrogen Peroxide as a means of upgrading olefins. It contains facts, describes the methods, and lists many present and potential applications.

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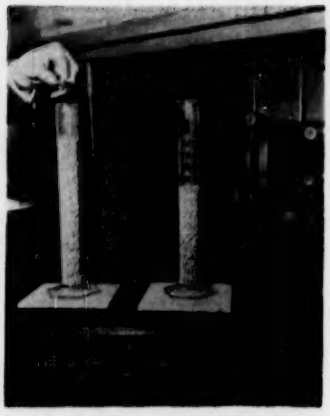
trace quantities of metals act like dryers in a paint. After conventional asphalt is applied, the trace quantities of vanadium appear to produce a skin over the asphalt which ultimately penetrates through the entire layer applied. Hence blisters, and cracks in the asphalt.

In the case of the new roofing compound, a special chemical refining process, which is a part of the production procedure, converts the trace metals from active compounds into minerals so that they become inert, filler-type materials. As a consequence of the conversion from metals to minerals, the film deposited by the new roofing compound retains its adhesiveness for a long period of time. Aging in the new compound proceeds much more slowly than in conventional asphalt roofing.

The new product is especially well suited for use on raw concrete roofs. It completely eliminates the use of felt, gravel and, in most instances, metal edging.—**Panther Co., 840 North Main St., Fort Worth, Tex. 174D**



Desulfurization Catalyst

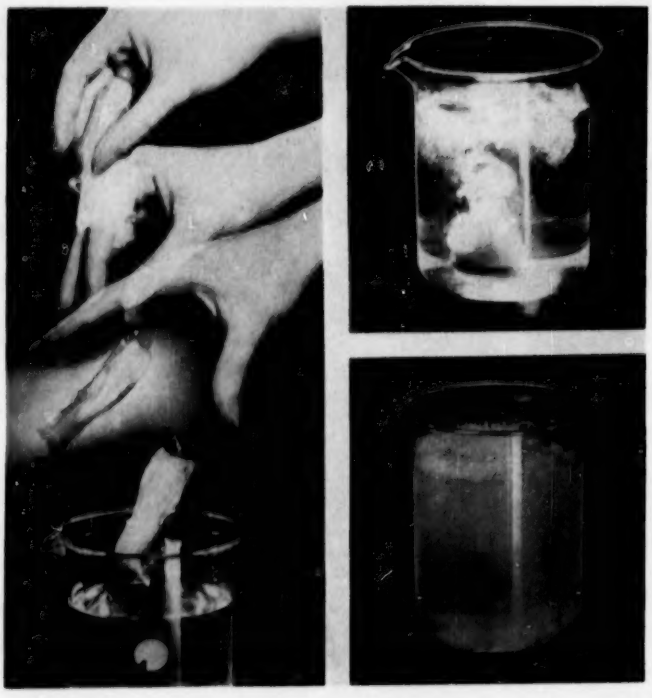
Low bulk density of new catalyst, right, boosts activity per pound.

A new extruded cobalt-molybdena catalyst reduces the sulfur content of petroleum fractions by conversion to hydrogen sulfide.

Extensive laboratory and field performance data shows greater sulfur and nitrogen removal efficiency than other cobalt-molybdena types. Higher active metals content, superior porosity and low bulk density are also cited as significant improvements over existing catalysts.

According to the manufacturer, the low bulk density combined with high activity means that refiners now can treat the same throughput with fewer pounds of catalyst (up to 30% less) or increase throughput on the same quantity of catalyst, and without any drop in treating level.

Designed for service in both new and existing facilities, the new catalyst — called AERO HDS-2—is said to regenerate easily with little loss of activity or crush strength.—**American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y. 176B**



PVA Packaging Film Dissolves in Seconds

A new polyvinyl alcohol water-soluble film called Reynolon is offered as packaging material for soaps, detergents, fertilizers, paints and tints, anti-rust agents, insecticides and other water dispersable products.

While providing product protection during shipping and storage, the new film eliminates need for consumer to open the package and to measure out desired portion. Where used for packaging insecticides or other harmful agents, it does away with the need for any direct human contact with the product. It has contact clarity, permits product display.—Reynolds Metals Co., Louisville, Ky. 176A

Plasticizer

Improves vinyls for high-humidity use.

New polymeric plasticizer, Paraplex G-54, for vinyl chloride polymers is of particular interest for applications where

Unique reactivity characteristics excite industry
New applications discovered daily

Hydroxylamine salts have reactivity characteristics possessed by no other chemical. Already being put to work in a wide range of uses, these versatile nitroparaffin derivatives offer exciting potential to all chemical explorers.

FOR SYNTHESIS For making oximes, hydroxamic acids and numerous intermediates, for preparation of anti-skinning agents, anti-rusting agents and pharmaceuticals.

AS ACID-STABLE REDUCING AGENTS For metallic ions such as ferric, cupric, silver and for nonmetallics such as dyes, peroxides and nitrates. For purification processes, dyeing of acrylic fibers and as a short-stopper for catalyzed polymerization reactions.

FOR OXIDIZING The hydroxylamines are probably mild oxidizing agents in alkaline solutions. Further explorations called for.

EFFECTS ON PROTEINS AND BIOLOGICAL SYSTEMS For inhibiting enzymes such as catalase, for hardening gelatine. Derivatives are good fungicides and bactericides. This is a relatively unknown "land" ideal for pioneering.

NOW AVAILABLE IN COMMERCIAL QUANTITIES Now available in quantity at moderate prices. Explore the hydroxylamine salts. For samples and complete technical data, fill out coupon and mail today.

DISCOVER THE NITROPARAFFINS!

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Please send me: ☐ Technical data on the Hydroxylamines ☐ Sample of Hydroxylammonium Chloride ☐ Sample of Hydroxylammonium Sulfate ☐ Sample of Hydroxylammonium Acid Sulfate

NAME..... TITLE.....

COMPANY.....

STREET.....

CITY..... ZONE..... STATE.....

freedom from exudation on exposure to high humidity is essential.

Vinyl compounds plasticized with Paraplex G-54 are said to have very good resistance to oils, gasoline, soap and detergents. Such compounds are also well suited for use in contact with polystyrene, modified and unmodified, with rubber base materials, nitrocellulose, enamels and alkyd type finished. The reason is the resistance of the new plasticizer to migration.

Paraplex G-54 is in the same molecular weight range as the company's G-53 and has advantages over the latter in such areas as: retention of compatibility in high-humidity service; plasticizing efficiency; processing characteristics in both dry blending and Banbury-milling cycles; handling properties by virtue of its lower melting point. — **Rohm & Haas Co., Washington Sq., Philadelphia, Pa.** 176C

BRIEFS

Phosphoric acid used as a soil stabilizing agent in construction projects may overcome problems of heavy clays. Tests have shown that if 2% of the acid is added to a fat plastic clay and the material compacted, a hard, durable mass is produced that will withstand prolonged exposure to water and to wintering. —**Monsanto Chemical Co., St. Louis, Mo.** 178A

First adhesive for Dacron said to produce high-strength adhesion is Chemlok 401. It bonds Dacron and nylon to uncured natural rubber, GR-S, neoprene, butyl and Buna N elastomers. It consists of a solution of polymeric consituents and dispersed pigments in a nonflammable, organic solvent which is mixed on the job with an isocyanate curative. — **Lord Mfg. Co., Erie, Pa.** 178B

Lacquer coating material, Saran Resin F220, is distinguished from other saran resins by its low viscosity and complete solubility in acetone. F220 gives polyethylene film greater clarity, improved gloss and slip, and it improves chemical resistance of a wide variety of packaging materials. — **Dow Chemical Co., Midland, Mich.** 178C

Two titanium alloys which offer superior properties for high temperature applications have been introduced. One was developed to meet the aircraft industry's need for a titanium sheet alloy which can be readily formed, then heat treated to high strength. Strength can be more than tripled by heat. The second alloy has high temperature strength substantially superior to that of comparable alloys now available. — **Mallory-Sharon Metals Corp., Niles, Ohio.** 178D

High-density casting compound Maraset resin 341 is a lead-filled epoxy formulation. It provides a barrier against radiation, spurring its use in shields for nuclear installations and containers used to ship radioactive materials. Available in various lead loadings up to 95% by weight, it offers a wide range of hardnesses. — **Marblette Corp., Long Island City, N. Y.** 178E

New aldehyde and alcohol, 2,2-dimethyl-4 pentenal and its corresponding saturated alcohol, 2,2-dimethylpentanol are now offered in research and pilot plant quantities. Absence of hydrogen on the alpha carbon atom in the alcohol molecule suggests its use as a terminating agent for polyesters or in other reactions where dehydration stability is required. — **Eastman Chemical Products, Inc., Kingsport, Tenn.** 178F

Room-temperature vulcanizing silicone rubber, Silastic RTV 501, is recommended for encapsulating electric and electronic parts for general potting, sealing and caulking applications. — **Dow Corning Corp., Midland, Mich.** 178G

New man-made rubber compound withstands both subzero cold and temperatures higher than its own vulcanizing point. First use of the new materials is in a lightweight, flexible membrane for the fueling system for Boeing Airplane Co.'s area defense missile. Used as a coating for a nylon fabric diaphragm, it withstands a wide temperature range and is not affected by the jet fuel in which it is immersed. — **B. F. Goodrich Aviation Products, Akron, Ohio.** 178H

Polyolefin, designated Fortiflex A500, is said to have unusually good flow characteristics, of advantage in molding larger parts without using excessive molding temperatures. — **Celanese Corp. of America, 180 Madison Ave., New York, N. Y.** 178I

Petrochemicals additive reduces the difficulties resulting from the presence of fine rust particles in aviation gasoline and aircraft turbine fuels. Called Texaco Aircraft Fuel Inhibitor, the new corrosion preventive has an inhibiting action which is polar in nature. It does not react with the metal surfaces it contacts. It is wholly petroleum derived; there are no metallic elements in its composition.—**Texas Co., 135 East 42nd St., New York, N. Y.** 178J

Textile softener, Synthavon SL, can be applied to cellulosic yarn and fabrics. It is inexpensive and is particularly suitable for undyed yarns and fabrics as it does not yellow or cause rancidity.— **Arnold Hoffman & Co., Providence, R. I.** 178K

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For 16 years an important link in TRI-SURE THE WORLD OVER

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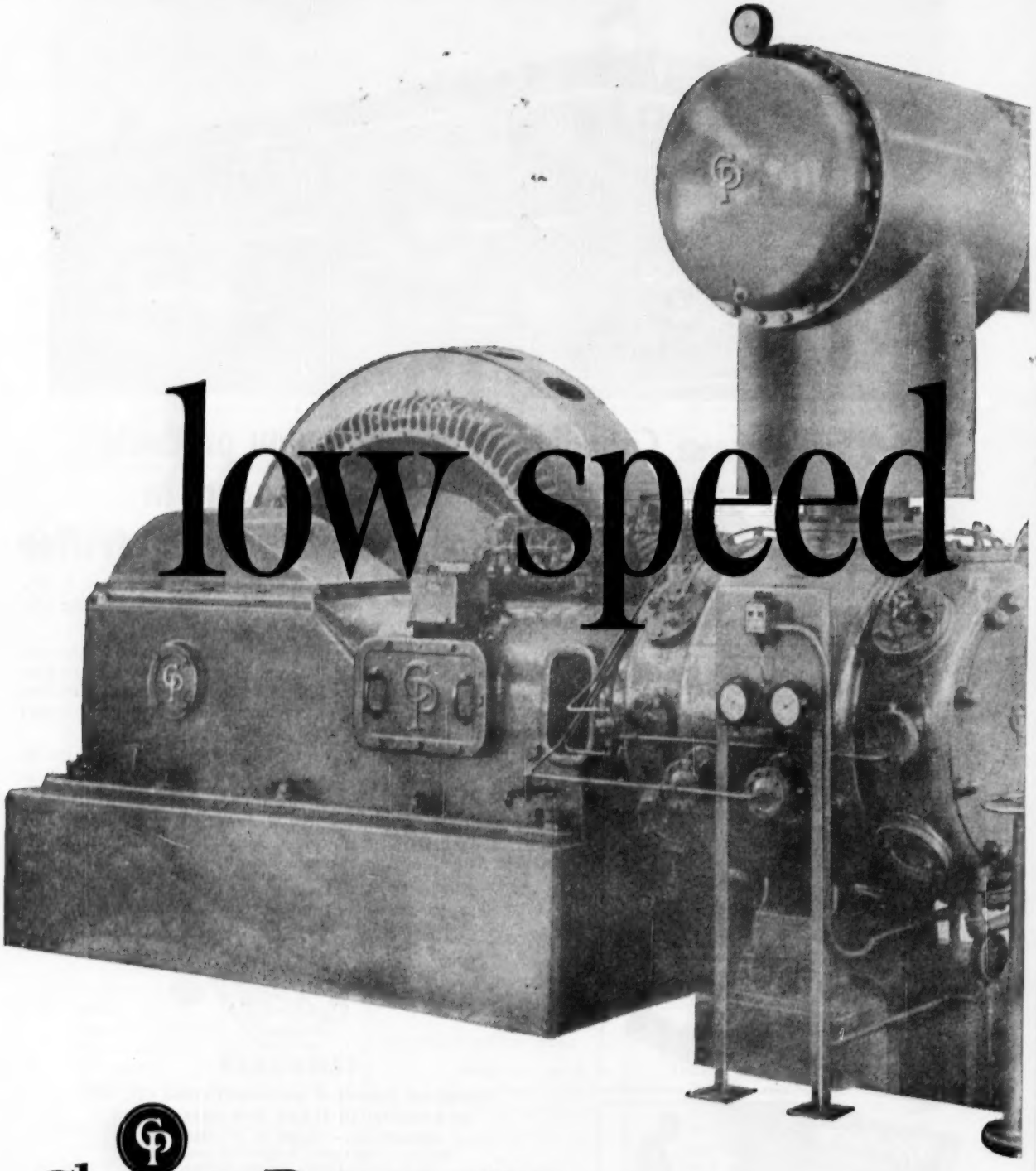

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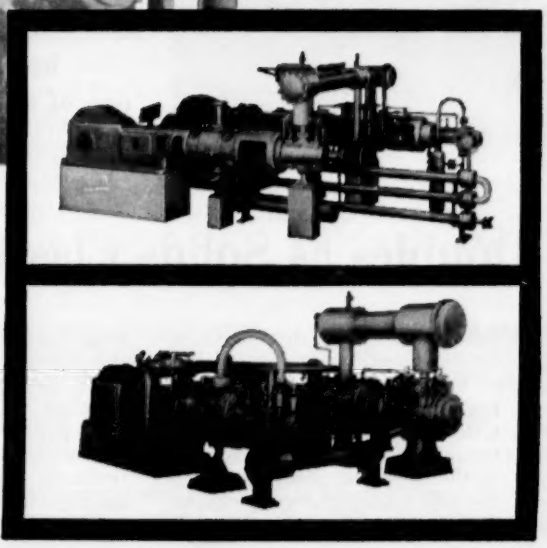
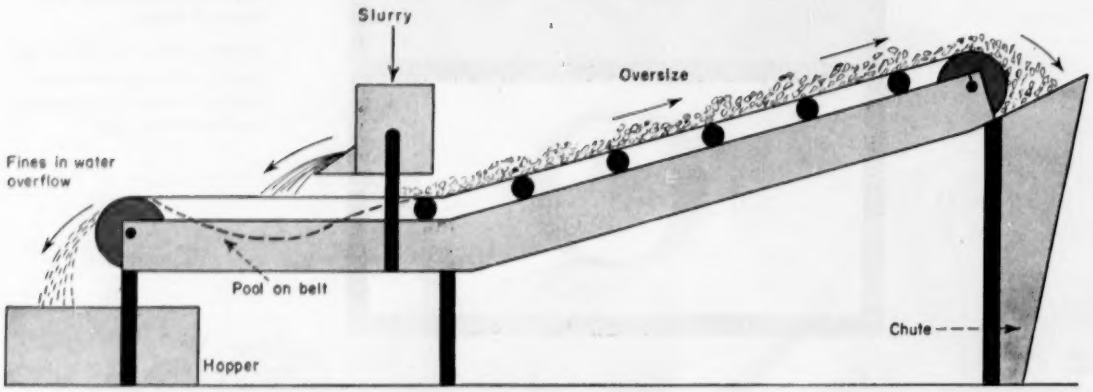
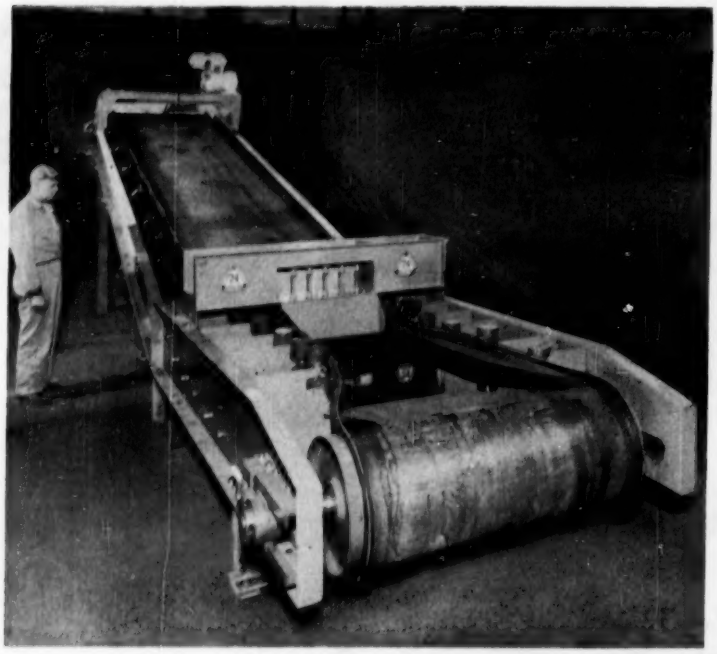


Class OCE-5 five-stage, horizontal duplex ethylene gas compressor.

Four-stage Class OCE-4, slow-speed compressor handling hydrogen at 3000 psig.





Hybrid Denver-Finney classifier combines belt conveying with surface-current hydraulic classification of solids.

Belt Conveyor Doubles as Solids Classifier

Belt conveyors are today's sinews of industry. Therefore, it's not surprising to see a belt conveyor modified to fit the dual role of classifier and conveyor handling heavy tonnage flow in a ball-mill circuit. You might even say, "It's a natural."

► **Wet Spot on Belt**—First commercial model of the Denver-Finney classifier now operating on ore is such a machine. Solids are separated according to particle size in a pool held by a trough in the belt at one end of the conveyor. Pool overflows the tail pulley carrying off the fine fraction in hydraulic suspension. Coarse fraction settles onto the moving belt and moves out of the pool in the opposite direction to discharge over the head pulley.

Reputedly, the pool provides surface current conditions claimed to be most desirable for good classification. Pool is

No Repairs in a Full Year of Round-the-Clock Service

In the chlorinated products division of Diamond Alkali Company at Painesville, Ohio, these LaBour Type G pumps—purchased in 1948—are on continuous duty, lifting chlorinated solutions to the cooling towers above the mixing tanks. Each of the four pumps lifts about 120,000 gallons per day, to dissipate heat produced by introduction of the chlorine into the process of manufacturing chlorowax, carbon tetrachloride and anhydrous hydrochloric acid. Ten other LaBour pumps serve other divisions of the Painesville plant.

In 24-hour service atop the 15,000-gallon mixing tanks, the LaBour pumps take a beating, but they deliver the work they were bought to do. Sometimes a full year goes by without the necessity for any repairs or replacement parts. LaBour Type G is packingless, so there is never any need for servicing to prevent packing leaks.

If you are looking for this kind of dependable, low-cost service in your liquid moving operations, get in touch with LaBour.

LABOUR

Equipment Developments This Month

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agitated a minimum amount so that much less volume is required than for mechanical classification.

Since the belt forming the bed of the pool is all that moves, no teeter beds are created to bring up tramp oversize when the density margins are close. Solids settle onto the belt at such low velocity that friction wear is less than would be evident on the same conveyor handling dry material.

▶**Built to Fit Job**—You can see that the close kinship of the Denver-Finney classifier to an ordinary conveyor permits building units to satisfy individual job needs. Thus, pool can have sufficient length to give any desired flow length, pool area and volume without creating excessive depth and high-density hindered settling zones.

Also, length of the drying deck can be any dimension necessary to remove the solids and discharge them at the required elevation. Belt can operate at slopes up to 4 in./ft. without slippage.

▶**Clean Cuts**—Point of feed entrance seems most satisfactory close to where the coarse fraction leaves the pool. Washing of feed across the coarse particles tends to remove any adhering fines. Flow velocity down the pool is high enough so that few fines settle onto the belt. Net result produces clean cuts.

Equipment Cost Indexes

	March 1957	June 1957
Industry		
Avg. of all	222.2	224.1
Process Industries		
Cement mfg	213.1	215.3
Chemical	223.3	225.5
Clay products	207.0	209.2
Glass mfg	210.9	213.0
Paint mfg	214.8	216.6
Paper mfg	215.2	217.3
Petroleum ind	219.3	221.1
Rubber ind	222.1	223.9
Process ind. avg	220.7	222.8
Related Industries		
Elec. power equip	225.6	228.4
Mining, milling	224.7	226.9
Refrigerating	250.9	253.0
Steam power	210.3	212.0

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; March 1957, pp. 266–7 for annual averages since 1913.

▶**Gain for Ball Milling**—In mineral milling, the ball mill and classifier circuit often is the most expensive and restrictive step in the entire operation. From total tonnage moving through the circuit during any time interval, only 20-25% is removed as the fine fraction; the remainder makes up the circulating load returned to the mill for more grinding.

With such a high proportion of total load recirculating, power consumption, wear and tear run high per unit product. This is particularly true with rake or spiral type classifiers.

But the Denver-Finney design apparently overcomes some of this problem. That's because belt conveying is the best way to move material from one location to another. Power requirements are low, moving parts wear little.

▶**Leach and Wash**—While touting their unit's virtues as a classifier, Denver engineers are equally enthusiastic talking about its use as a leacher and washer. Several units can run in series to provide the efficiency of a multi-stage leaching and washing operation.

To withstand corrosive con-

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Progressive designers, the men who lead the trend toward miniaturization, depend on ASCO as the one source for a full line of midget solenoid valves. The unexcelled quality and dependability that ASCO pioneered in the solenoid valve field is found, too, in today's midget solenoid valves. Only the size has been reduced.

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ASCO Midget Solenoid Valves are available with standard, watertight or explosion-proof enclosures. Pipe sizes ⅛" and ¼"; pressure range 0-1000 psi.

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ditions, the unit can be constructed with acidproof protection.—**Denver Equipment Co., Denver, Colo.** 182A

Paste Mixer

For laboratory, cleans easily and rapidly.

Major labor savings accrue from use of the new Z-blade laboratory mixer when carrying out extensive formulation programs with viscous or pasty materials. Unit takes down rapidly between batches, if required. Although able to hold 1 pt., it can mix efficiently as little as 5 cu. in.

Developed for formulation of rocket propellants, the Z-blade mixer can operate under vacuum, with controlled temperatures, or with inert gas blanketing. Design prevents grease leakage from bearings or paste from entering drive.

All parts that contact process material are constructed from corrosion and abrasion resisting materials.—**Atlantic Research Corp., Alexandria, Va.** 186A

Side-Entering Mixer

Services easily without interrupting storage program.

Turbo-Mixer's new side-entering propeller mixers can be serviced readily without interruption of the tank storage program. A closure seals the tank while you repack the stuffing box or replace a seal.

In this mixer, bearing housing is designed to retract intact, leaving the bearings in perfect alignment. To retract the housing, only two bolts need to be turned. The gear-motor does not move during the operation.—**Turbo-Mixer Div., General American Transportation Corp., 380 Madison Ave., New York 17, N. Y.** 186B

Customer Service Lab

Now larger and more complete to serve better.

J. H. Day's larger, more complete customer service laboratory was opened recently. Providing the most modern facilities, this new laboratory runs product tests to simulate full-scale production.

Laboratory is staffed by a qualified and highly experienced team of technicians. Equipment includes mixers, blenders, sifters, mechanical and Airmatic conveyors.—**J. H. Day Co., Div. of Cleveland Automatic Machine Co., Cincinnati 12, Ohio.** 186C

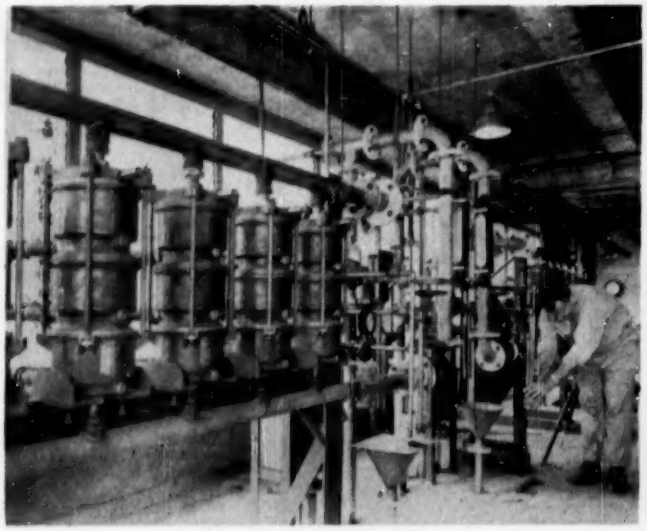
Gas Dryer

Dehumidifies without need for regenerating heat.

With the new Industrol heatless dryer, you get a continuous flow of super-dried air without any need for reactivation heat. As a result of eliminating heat, unit is virtually free of corrosion problems, needs no explosionproofing, requires no insulation and is less expensive to install and maintain.

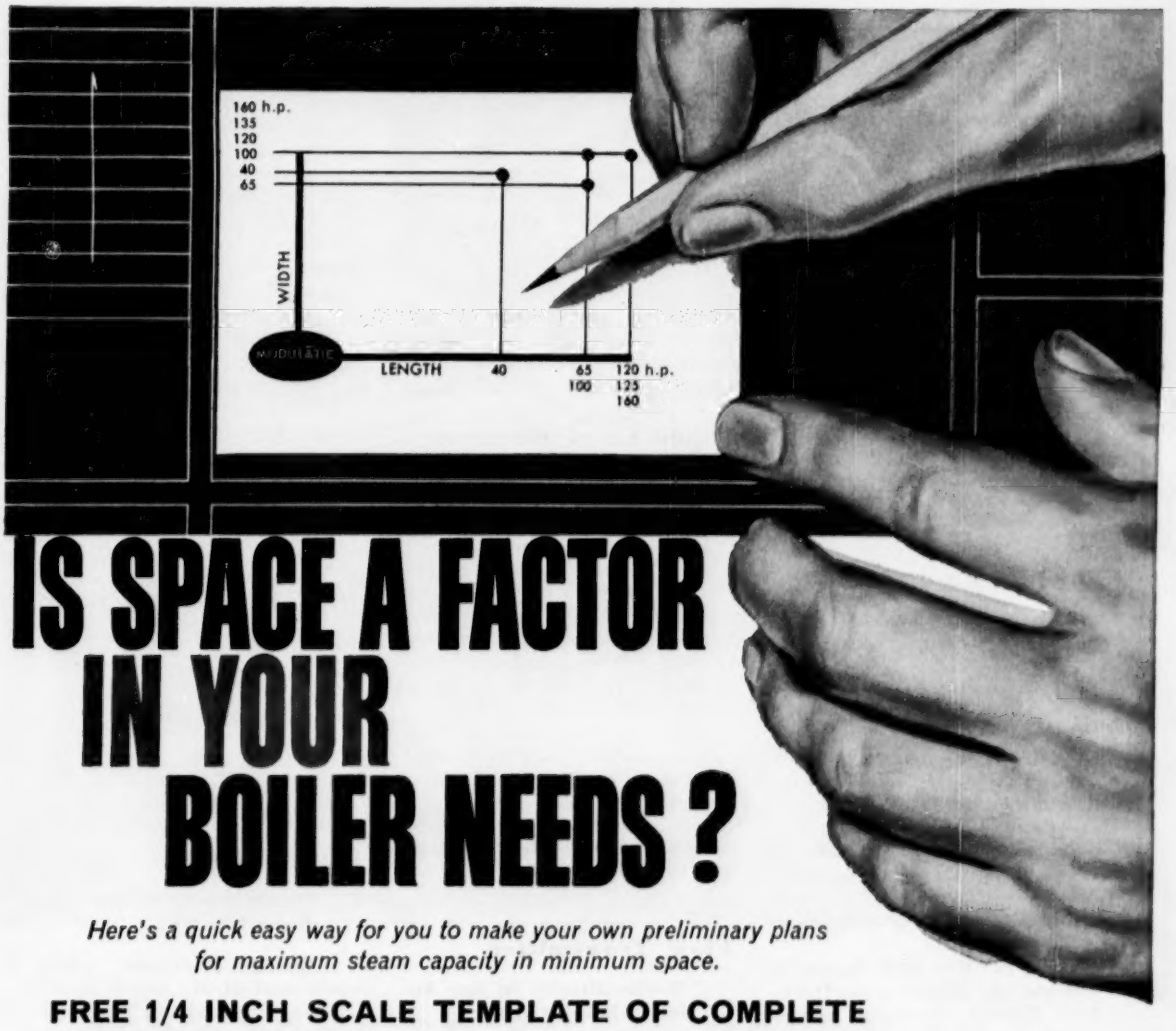
Manufacturer explains how unit operates by stating only that the long-lasting ability of a standard dessicant to reach equilibrium with its surroundings eliminates need for either steam or electric heaters.

Unit will be offered in 18 models with chamber sizes from 2 to 30 in. dia., capable of delivering air or gas at effluent dewpoints of −100 F. or lower at line pressure. — **Trinity Equipment Corp., Roselle Pk., N. J.** 186D



Midget Cyclones Recover Starch From Filtrate

This installation of Dorrclones at A. E. Staley Mfg. Co.'s new starch dryer building, Decatur, Ill., recovers finely dispersed starch remaining in the filtrate and wash water from a battery of rotary vacuum filters. Concentrated suspension discharging from the Dorrclones recycles back to the filter feed. Each Dorrclone housing contains a nest of midget cyclones, particularly suited for recovering fine solids. Staley's new facility will improve quality of starch because it incorporates the latest developments in equipment to process starch. — Dorr-Oliver Corp., Barry Pl., Stamford, Conn. 186E



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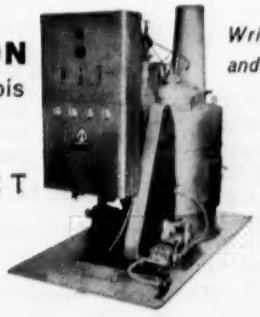

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THE WORLD'S MOST COMPACT POWER PACKAGE

Thickness Gage

Completely portable, battery-powered, ultrasonic type.

For non-destructive testing of rigid materials such as metal or glass, the Sonizon SO-200 offers completely portable rapid testing. It can locate corrosion or wear on storage tanks, pipes, dryer rolls and other structures accessible from only one side. Also, it will detect lack of bond between materials or lamination in one material.

Fast, positive and simple to operate, the SO-200 reads thickness directly. Operator selects proper crystal range, places probe on test area and rotates the circular read-out dial until the harmonic lines match a pattern of flashing lights. Then, he reads thickness directly from the dial.

Instrument requires no warm-up time. It measures within ±3% accuracy between 0.027 and 4 in. thickness.—**Magnaflux Corp., 7300 West Lawrence Ave., Chicago 31, Ill.** 188A

Valve Positioner

Links electric signal to pneumatic positioner.

With Fisher's new electro-pneumatic valve positioner, you can convert any Fisher Positrol valve positioner, now in service, to receive an electrical signal and transduce it to operate the pneumatic control valve.

Transducer attaches to side of standard Positrol. Through correct choice of coils, it can receive d.c. electrical output signal from any instrument now on the market. Output from the transducer is 3-15 psi. air pressure.

Transducer case is explosion proof and is continuously purged with air through an explosion-proof vent. — **Fisher Governor Co., Marshalltown, Iowa.** 188B

Liquid-Level Electrode

Rated for extremely high pressure and temperature.

Believed to be the only one available in its pressure range, the Auburn HP 10 liquid-level electrode is rated for pressures to 10,000 psi. and temperatures to 700 F. Originally, it was developed for use in removing water from helium gas.

Electrode features a new type glass center-electrode seal, a captive copper compression gasket. stainless-steel shell and 95% aluminum oxide insulator. —**Auburn Spark Plug Co., Inc., 104 York St., Auburn, N. Y.** 188C

Flow Transmitter

Works directly in line below rotameter range.

Minimum flows in the range of 0.003 to 0.010 gpm. of clean water and 0.01 to 0.04 scfm. of air or gas are measured and transmitted by the new integral orifice d/p cell transmitter. Device satisfies research and pilot plant needs. And it fits into process operations such as ratioing small flows.

Instrument has a manifold with a removable orifice through which flows the stream being measured. Differential pressure across the orifice is applied to the high and low pressure sides of a standard silicone-filled twin diaphragm capsule. Balancing of this differential by a pneumatic feedback mechanism produces a 3-15 psi. output signal proportional to differential pressure.

Transmitter installs directly in a process line, needs no separate primary device or meter leads. By simple removal of manifold, orifice can be changed for different flow range.—**Foxboro Co., Foxboro, Mass.** 188D

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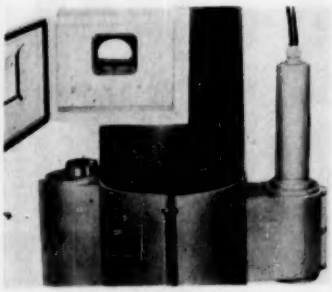


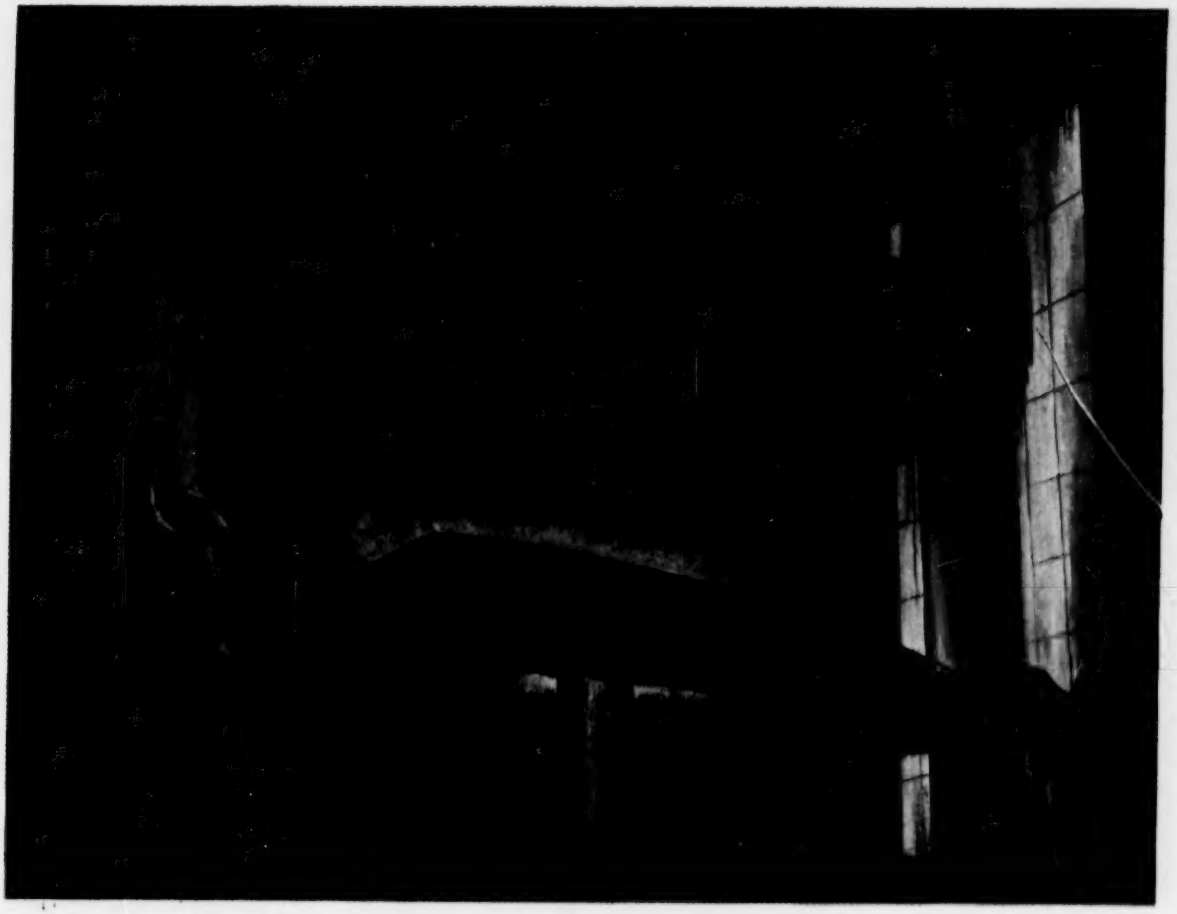
Density Gage

Standardized version of radioactivity type.

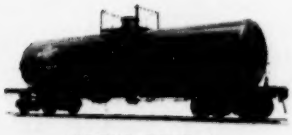
Utilizing principles previously applied to custom installations, the model LSG standardized radioactivity gage measures density, specific gravity or percent solids of material. When installed on a 10-in. pipe, instrument realizes a span of 0.2 and a precision of ±0.004. It may also be used to indicate an interface in the pipe.

All measuring components of the instrument are external to the system enclosing the process material. For that reason, instrument is not affected by process conditions of high or low temperature, pressure, viscosity, corrosion or abrasion.

Other advantages listed for this gage include simple, economical installation; minimum maintenance, sturdy construction; no moving parts and easy calibration. Safe operation is assured by a unique lead-shielding holder for the radioactive source and by lead-laminated brackets.—**Ohmart Corp., Dept 110, 2236 Bogen St., Cincinnati 14, Ohio.** 188E



4000 TONS TO KILL A MOSQUITO ?*



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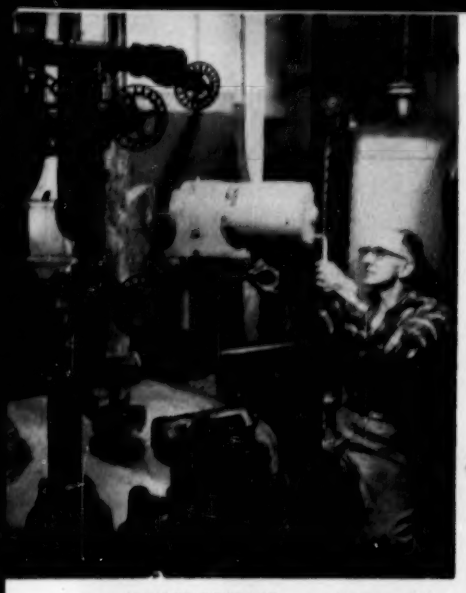


ELECTRICIAN completes wiring gear motor in processing area.

New Gear Motors

Offered through national power transmission outlets.

Convinced that gear motors and related transmission equipment should be offered to industry as shelf items rather than as specialized products, GE's Gear Motor and Transmission Components Dept. is presenting such a line beginning Oct. 1 this year.

Three basic components are offered to satisfy industry's increasing need for compact and versatile speed reduction:

- An integral-type unit, equivalent to previous GE designs where gear and drive motor are packaged into a single unit.
- An all-motor type with the drive motor coupled to the gear reducer and mounted on a common carrier.
- A separate helical speed reducer which may serve with a variety of prime movers.

On all three components, mounting dimensions are identical for similar rating. Parts are interchangeable, giving the user maximum flexibility in back-up parts and units.

▶ **New Design Outlook**—Latest technological advances in gear manufacture have been engineered into the double-helical gear design.

Design permits altering ratio by changing pinion and gear in the first stage only. Means for removing and replacing the pinion and gear are designed into each unit as captive assemblies.

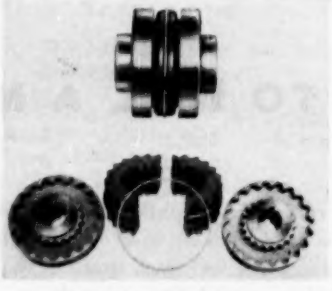
Units can satisfy a broad range of mounting requirements without factory alteration. A simple oil-level kit allows adaptation in the field to extreme positions.

Gear housing is completely accessible from either end and can be disassembled without loss of alignment.

▶ **Three Basic Reductions** — Speed reductions available in the new line include: single reduction offset shaft in speed ranges from 780 to 350 rpm.; double reduction concentric shaft for speeds from 350 to 37 rpm.; and triple reduction concentric shaft for output speeds from 30 to 13.5 rpm.

Integral-type gear motor ratings up to 10 hp. will be available Oct. 1. Other ratings up to 30 hp. will be completed by Feb. 1, 1958.

Separate helical speed reducers and all-motor gear motors will be developed to cover range of 1-75 hp. by July 1958. —**General Electric Co., Gear Motor and Transmission Components Dept., Paterson, N. J.** **190A**



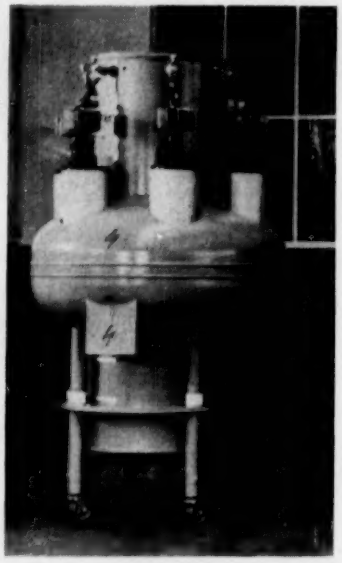
Flexible Coupling

Will not wear under misalignment, or vibration.

For use wherever mechanical power must be transmitted, the new Sure-Flex flexible coupling will tolerate angular misalignment up to one degree; parallel misalignment from 1/32 to 1/16 in., depending upon shaft size; and free end-float up to ⅛ in., depending upon size. Under such conditions, the Sure-Flex doesn't wear, even when suffering internal abuse or high resisting forces.

Coupling has three basic parts: two hub flanges and a two-piece rubber sleeve.

Internal and external teeth of the flexible sleeve mate with the flange hub teeth and lock tight under load.—**T. B. Wood's Sons Co., Chambersburg, Pa.** **190B**



D.C. Rectifiers

Pumpless, gas-filled type.

Pumpless steel tank rectifiers filled with mercury vapor or inert gas have been added to the Swiss Secheron line of heavy duty electrical equipment now offered on the U. S. market. With rare gas in the tank, buildup of overvoltage on the anodes is prevented.

Because of this feature, these rectifiers are not hampered by low cooling-air temperatures. They need not be preheated and can be switched at once to full load after idling in cold ambient temperature. One thermostat on the tank controls cooling temperature by operating a fan; another disconnects rectifier if tank gets too hot.

At the present time, standard production models include various sizes of single- or six-anode tanks for d.c. voltages up to 1,800. For larger overloads or voltages above 1,800, rectifiers are designed to order. — **Secheron Works Co., Geneva, Switzerland.** **190C**

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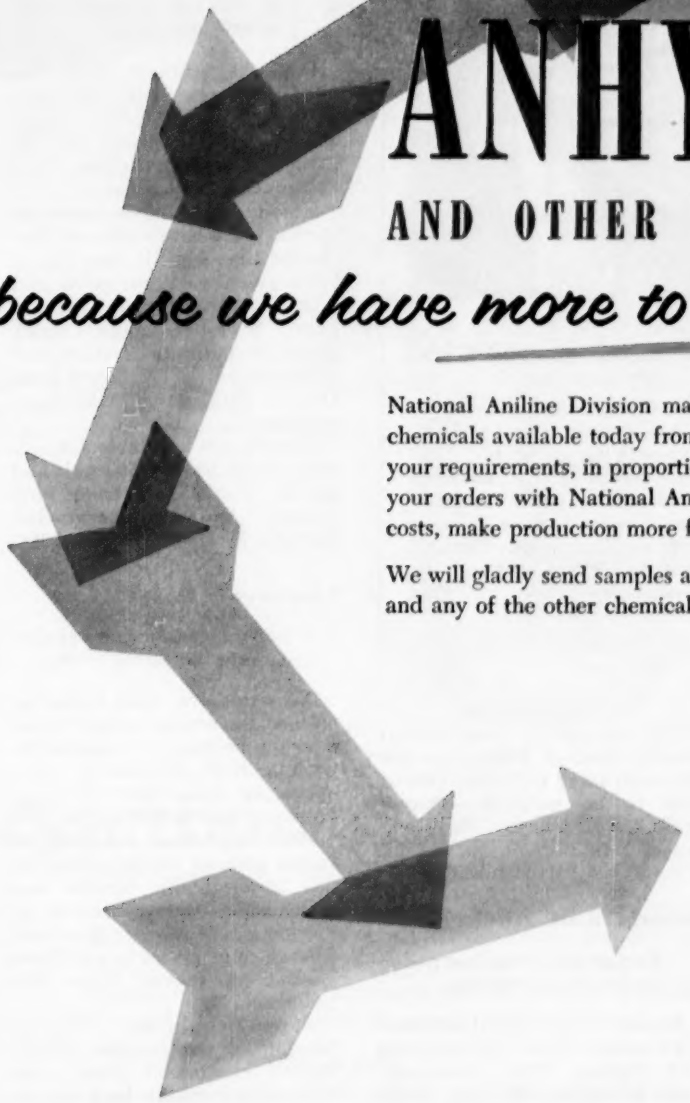

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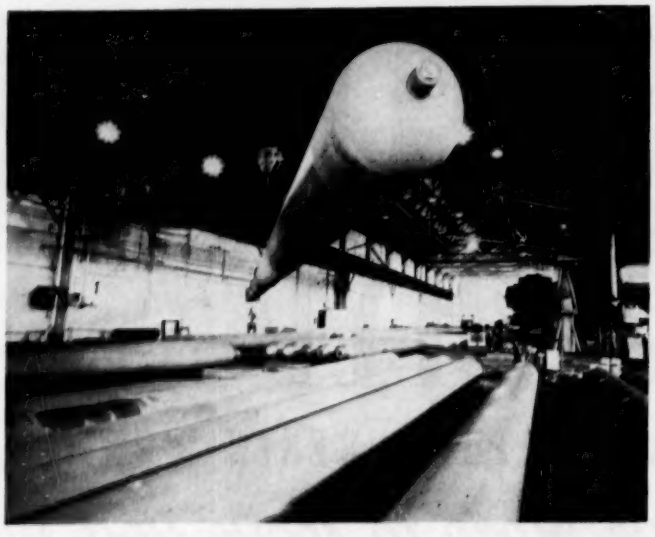


New Breed of Giant Cylinders Store Industrial Gases

Looking like a wonder of the modern era, this giant 80-ft. steel cylinder is but one of 30 built to store high-pressure oxygen at a Granite City, Ill., oxygen plant. To handle this and other types of high-pressure gas storage, present-day cylinders hold pressures from 500 to 10,000 psi. with wall thicknesses up to 3 in., lengths from 3 to 80 ft., diameters up to 30 in. While some cylinders are made of stainless steel, most are high-alloy steel developed to meet high pressure needs.—National Tube Div., U. S. Steel Corp., McKeesport, Pa. 192A

Checkweigh Scale

Offers high accuracy on production basis.

Weighing with laboratory accuracy on a production basis, a new checkweighing scale functions without use of knife-edge pivots. Rather, it relies on a flexure-plate leverage system which in many instances has performed more than 15 million weighings without losing accuracy or sensitivity.

Developed for checkweighing packages of expensive chemicals and rare earths, this scale indicates weight decimally on a direct-reading register either in lb. or grams. Available in various capacities, scale can be furnished with a ticket printer, chart recorder, remote weight indicators, fully automatic conveyor systems for complete automatic control. Platforms can be constructed to fit the size of item to be weighed.—**Thayer Scale Corp., Thayer Pk., Pembroke, Mass. 192B**

Drums and Buckets

Protected from corrosion by resistant coating.

Miccrosol vinyl plastisol coating protects a new line of drums and buckets from corrosion. Coated inside and out, these containers are reported ideal for storing acids, caustics, plating solutions and all types of corrosives. Miccrosol is bonded to the steel and is extremely tough to resist physical damage.

Drums are available in 55 and 30 gal. sizes with securely welded handles for easier handling. Also, drums without handles can be furnished. Buckets come in 5-gal. capacity. —**Coating Div., Michigan Chrome & Chemical Co., 275 Iron St., Detroit 14, Mich. 192C**

Storage Containers

For storage of liquid oxygen and nitrogen.

Low-loss storage units for liquid oxygen and nitrogen now are in production. Units are all built to ASME specifications mounted on either skid, caster wheel or trailer.

Among standard features on the units are bottom fill and discharge line, top fill line, liquid level gage, vacuum valve and filters, thermocouple vacuum gage, pressure gage, quick pressure build-up system and extended valves on liquid lines ending with quick disconnect couplings.

Vessels are available for volumes from 50 to 3,500 gal. and up to 10,000 gal. from bulk storage.—**Hofman Laboratories, Newark, N. J. 192D**

Conveyor Belt

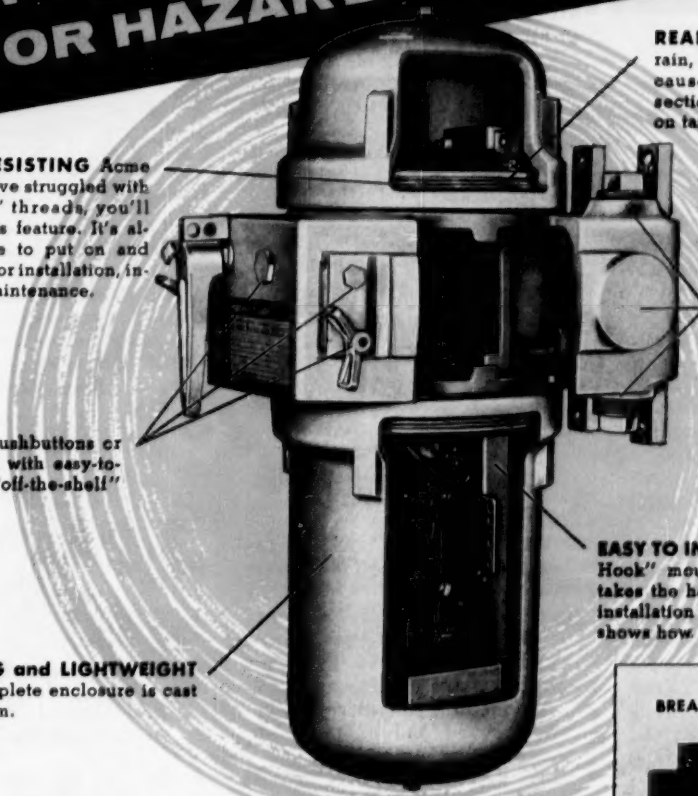
New construction resists damage better.

An exclusive manufacturing method for conveyor and transmission belting is reported to prolong belt life and to lower operating costs. Referred to as balanced belt construction, this method equalizes tension between plies of the belt through use of electronic tensile controls. Thus, each ply carries its proportionate share of any load. There are no premature failures caused by uneven stress distribution.

Supplementing the control of tension, a continuous vulcanization eliminates press overlaps which result in overcure and distortion of the fabric. Characteristics of cover and carcass are thereby kept uniform throughout the belt.—**Boston Woven Hose & Rubber Co., Div. of American Biltrite Rubber Co., Inc., P. O. Box 1071, Boston, Mass. 192E**

Square D announces...

NEW SPIN TOP ENCLOSURE FOR HAZARDOUS LOCATIONS



REAL PROTECTION against rain, dust, dirt and weather because male threads on collar section engage female threads on tank.

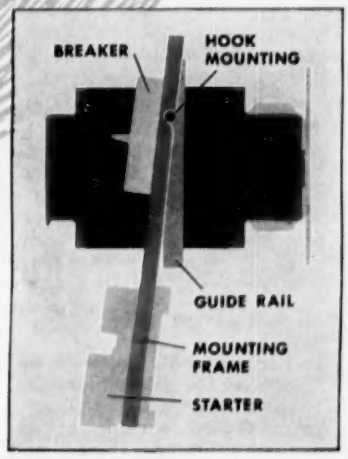
DAMAGE-RESISTING Acme thread. If you've struggled with "banged-up" threads, you'll appreciate this feature. It's always a breeze to put on and take off tanks for installation, inspection or maintenance.

INCREASED WIRING SPACE and through-feed conduit entrances for horizontal tap-offs.

EASY TO ADD pushbuttons or selector switches with easy-to-buy, easy-to-use "off-the-shelf" parts kits.

EASY TO INSTALL • "Slide and Hook" mounting arrangement takes the hard work out of the installation job. Diagram below shows how.

STRONG and LIGHTWEIGHT The complete enclosure is cast aluminum.



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The new **SPIN TOP** enclosure is available from your Square D Distributor in three ways—complete device, enclosure only, or components only...for reversing and non-reversing across-the-line starters and combination starters. And for combination and non-combination two-speed starters.

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EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

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Submersible Pump

Designed to handle wide range of corrosives.

A pump for submerged service with corrosive acids employs a vertical, close-coupled design within a housing. Motor of pump is enclosed type insulated with silicone to withstand working temperatures up to 266 F. Motor is cooled by liquid circulating through external jacket.

Open-bladed, centrifugal impeller is keyed directly to the motor shaft. A barrier chamber between the impeller and motor contains a barrier fluid to prevent entry of corrosive liquid into the motor.

When pump operates, pressure within the barrier chamber equals or exceeds the external hydrostatic pressure. If pump is shutdown, labyrinth seals of acid-proof graphite prevent the external liquid from entering the barrier chamber.

Pump shown above handled slurry of calcium sulfate in phosphoric acid at 122-140 F. for 5 mo. operating 18-20 hr./day. Motor is 2 hp. Material of construction: Type 316 stainless steel.—**Soc. Sicmi, Corso Venezia, 35, Milan, Italy.** 194A

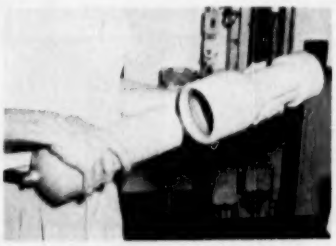
Cold Valves

Light-weight, pressure operated for shutoff service.

For shutoff service at extreme low temperatures and high pressures, there is a new line of pressure-operated valves. They provide bubble-tight control of flow through a media temperature range of −320 to +200 F. at pressures up to 3,000 psi. Typical materials handled include oxygen, nitrogen and air in both liquid and gaseous states.

Valves are available with operating times as fast as 25 milli-sec. for full stroke travel. Exclusive floating ball-seat valve arrangement is self-wiping and self-lapping to provide long, trouble-free life. Axial, hole-in-ball design gives an unobstructed, smooth flow path with minimum pressure drop at all rates of flow.

Valves are available for line sizes from ¼ to 3 in.—**Hydromatics, Inc., Cedar Grove, N. J.** 194B



Pipe Coupling

For use with PVC pipe, couples quickly.

Within seconds, you can assemble or disassemble a new "quick" coupling fabricated from high impact Koroseal polyvinyl chloride. It is recommended for temporary chemical, oil, water or disposal lines.

To install, you merely push the grooved end of pipe into the coupling until thrust ring seats in the groove. To disassemble, you set a disassembly tool in place and simply pull the pipe out of the coupling.

Quick-coupling pipe withstands high pressures, is available in 2-, 3-, and 4-in. sizes in standard 20- or 30-ft. lengths. Variety of fitting adaptors, disassembly tools and replacement gaskets permits easy use and maintenance in any installation.—**B. F. Goodrich Industrial Products Co., Marietta, Ohio.** 194C

High Vacuum Pump

Produces vacuum without using organic fluids.

Three-fold improvement in ion pumping speed coupled with greater dependability are reported for the new Evapor-Ion pump, Type EI-2000A. An electronic method produces high vacuum without using organic pump fluids. It is claimed to be the only device that creates a "dry" vacuum in the range from 10^{-4} to 10^{-8} mm. Hg.

The Evapor-Ion pump removes active gases by the gettering action of evaporated titanium wire. Inert gases are ionized and buried under a layer of titanium.

Unit pumps 1,900 liters/sec. of nitrogen, 1,000 liters/sec. of oxygen and 3,000 liters/sec. of hydrogen. Many other gases, including water vapor also can be handled at high speed.

No refrigerated traps or baffles are required. Mechanical fore-pressure pumping is not needed for continuous operation.—**Rochester Div., Consolidated Electrodynamics Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.** 194D

Quick Coupling

For thin-walled steel and aluminum pipe and tubing.

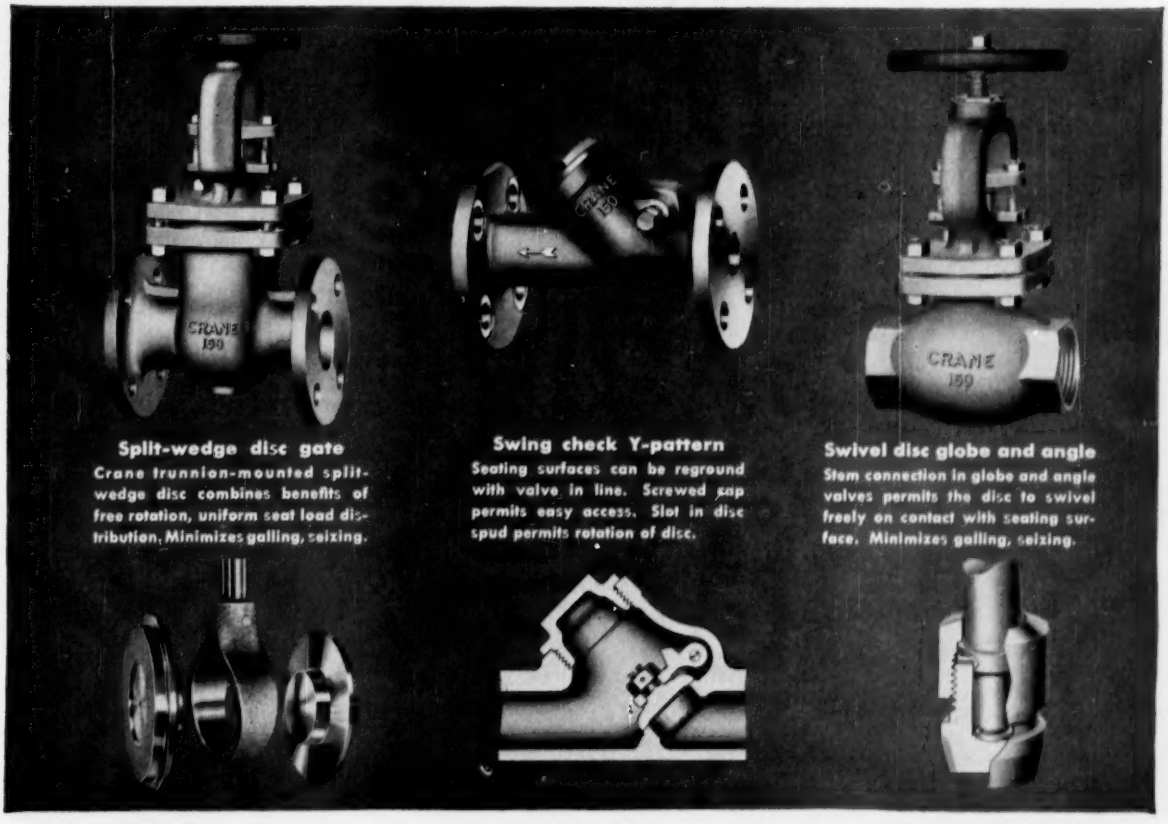
The new Vic-Easy quick coupling assures positive, leak-tight connection of thin-walled steel and aluminum pipe and tubing.

Economies possible through use of this coupling start with specification of light-weight tubing which can be utilized effectively with the Vic-Easy coupling. Then, transportation is less. And fewer men can install the light-weight tubing quicker.

Pipe or tubing coupled by the Vic-Easy method must have grooved pipe ends. Such pipe or tubing is supplied by leading pipe mills in a wide range of wall thicknesses and weights.

Coupling is quick and easy. When tubing ends are brought into position, coupling gasket is slipped onto one of the pipe ends. It is then positioned over the joint and the coupling

Cut your piping costs with CRANE corrosion-resistant valves



Split-wedge disc gate
Crane trunnion-mounted split-wedge disc combines benefits of free rotation, uniform seat load distribution. Minimizes galling, seizing.

Swing check Y-pattern
Seating surfaces can be reground with valve in line. Screwed cap permits easy access. Slot in disc spud permits rotation of disc.

Swivel disc globe and angle
Stem connection in globe and angle valves permits the disc to swivel freely on contact with seating surface. Minimizes galling, seizing.

Are your alloy valve replacement costs too high? Do you have trouble preventing product contamination?

Thousands of processors who must handle and control the flow of corrosive fluids in production have solved these problems effectively with Crane alloy valves—18-8 SMo stainless steel and Craneloy 20.

These valves, in addition to providing high resistance to corrosion and protection from product contamination, also have construction and operating features that are unequaled in cutting maintenance and installation costs.

For complete information about Crane alloy valves for processing industries—application recommendations, materials, sizes, ends available, and companion fittings—write to the address below, or ask your Crane Representative.

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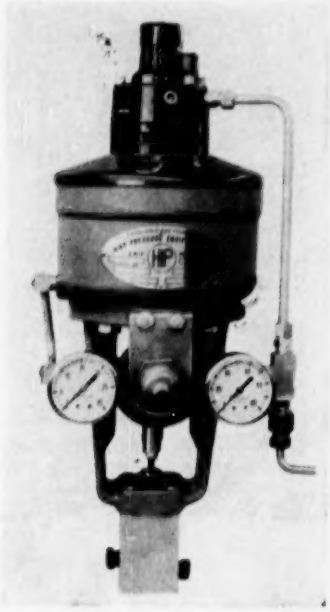
placed over it and fastened.

Vic-Easy couplings are available for thin-walled pipe and tubing in sizes from 1¼ to 12 in. Depending upon the wall thickness of the tubing and the type of coupling used, they may be used for working pressures up to 1,000 psi.—**Victaulic Co., of America, Elizabeth, N. J.** 194E



Control Valve

For system pressures up to 30,000 psi.

Exclusive design of a new proportioning control valve provides greater accuracy by a longitudinal stem lift in line with the piston. When this valve is installed with line air pressure, up to 100 psi., it provides both accurate and safe, automatic or remote control.

Deluxe metering valve with removable orifice, coupled with a Cono control, is manufactured for pressures ranging from 6,000 to 30,000 psi. and in sizes from ⅛ to ¾ in. It can be specified to meet explosionproof requirements and is available in materials such as Type 316 stainless steel, Hastalloy and Monel. It can be supplied in a complete package with electronic pressure sensing device for complete automatic operation.—**High Pressure Equipment Co., Inc., 1222 Linden St., Erie, Pa.** 196A

Spray Nozzle

Incorporates shutoff for use on manifolds.

A manually operated shutoff has been incorporated in a new spray nozzle designed primarily for manifold installations. Design satisfies need for shutting off individual nozzles to meet varying spraying requirements.

Nozzle is constructed with a diaphragm valve, shutoff screw and wing nut. To close the nozzle, the shutoff screw is turned down to hold the diaphragm in shutoff position. Wing nut locks shutoff screw.

When shutoff screw is set in open position, the diaphragm valve functions to shutoff the nozzle as soon as the manifold line is closed. This eliminates any dripping as line pressure is reduced.

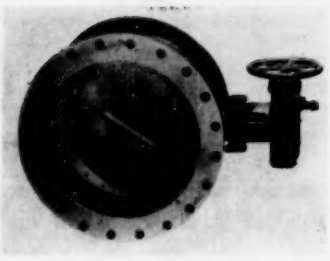
Wide choice of interchangeable orifice tips covers considerable capacity range as well as selection of full cone, hollow cone and flat spray patterns.—**Spraying Systems Co., 3275 Randolph St., Bellwood, Ill.** 196B

Jet Exhausters

Built to resist corrosive liquids or gases.

Water jet exhausters have been designed that resist corrosion while producing vacuum or mixing liquids and gases. Among the types of construction offered are linings of carbon or rubber, stainless steel, Haveg, Monel, Everdur, hard lead or even glass.

These exhausters are available with multi-nozzle inlets designed to provide high vapor handling capacities and low operating water pressures. Nozzles are positioned so that water enters the throat of the jet in converging streams. Corrosive vapors are drawn in to the exhauster, entrained by the water and discharged.—**Schutte & Koerting Co., Cornwells Hgts., Bucks Co., Pa.** 196C



Butterfly Valve

Operates easier and longer without maintenance.

Unusual operating characteristics based on a unique rubber seating principle are claimed for a new line of butterfly valves now in production.

Advantages claimed for this new type of butterfly valve include: lower operating torque, adjustability of seat for tight shutoff, seat replacement without removal of shaft or operator, elimination of shaft sealing problems as the rubber seat is a continuous ring integral with the disk, and increased operating cycles before part replacement or maintenance.

Darling - Pelton butterfly valves now come in sizes from 4 to 72 in. for pressures 50-250 psi. Valves are designed for all types of operation.—**Darling Valve & Mfg. Co., Williamsport, Pa.** 196D

Vaporizing Valve

Controls expansion of condensable vapors.

A new vaporizing valve controls expansion of condensable vapors several thousand fold, while maintaining intimate thermal contact with room ambient. Condensation is minimized or prevented entirely.

Radial inlet aperture of the valve is controllable in microinches. Inlet pressures up to several hundred lb. can be handled. Units with electric heaters and for automatic control are available, also. Standard materials of construction are brass or Type 316 stainless steel, unless otherwise specified.—**Manufacturers Engineering & Equipment Corp., Hatboro, Pa.** 196E

New book tells full story of stainless pipe and tubing

If you use stainless or high alloy pipe or tubing, this new illustrated handbook was written for you. It's 48 pages big – packed with informative data that you'll refer to again and again.

The table of contents is too long to list here, but it includes, for example, analysis and conversion tables, corrosion characteristics, weights, alloy properties, bending, joining and installation hints.

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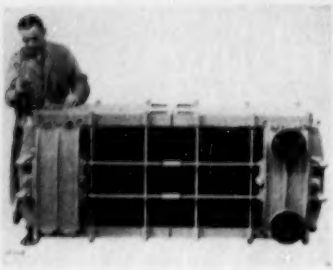


Heat Exchanger

Graphite block type in larger sizes.

Graphite block heat exchangers, available previously in cubic form, now are built in rectangular shape with more heat transfer surface and larger hole (tube) diameters.

Three different models provide effective surface areas of 100, 150 and 200 sq. ft. with ¾-in. tube diameter. Multiple pass arrangements of 1, 2, 3, 4, 8, 12 and 16 are available on both sides to suit the flow rates of both liquors and to give minimum pressure drop. Through alternative arrangement of tubes there is choice of two flow patterns.

Rectangular graphite block exchangers resist corrosion on both sides of the heat transfer surface. Over-all heat transfer is high under conditions of heating, cooling, evaporation and condensation. Both sides are readily accessible for cleaning and maintenance.—**Delanium Graphite Co., 134 Elmora Ave., Elizabeth, N. J. 198A**

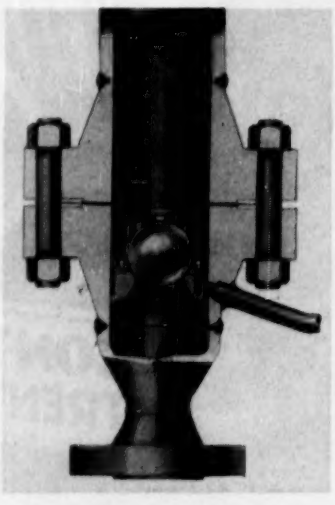
Packaged Heaters

Heat transfer oil for process heating needs.

Three installations have been completed of newly developed, packaged, multi-pass electrical heaters used with heat-transfer oil, Aroclor or Dowtherm. Design maintains low rate of heat input and high velocity of heat transfer medium to keep decomposition at a minimum.

Heater is built around a well-proven patented heating tube. Heating element is inside a round steel pipe, which in turn is inside a seamless square steel duct. Longitudinal baffles welded to opposite corners of the square pipe form two passages for flow of the heating oil. Thus, the oil makes two passes through each heating tube.

Packaged unit has one or more multi-pass heaters assembled horizontally. Tubes are either 5 or 10 ft. long rated 6 or 12 kw. Thus, packaged units can be furnished in multiples of 6 kw. up to any feasible size.—**Hynes Electric Heating Div., Turbine Equipment Co., Mountainside, N. J. 198B**



Desuperheater

With standard controller, holds steam to ±5° F.

Representing an advanced approach to desuperheater design, the variable-orifice desuperheater needs no long mixer pipe, spray nozzles, traps, glands, stuffing boxes or atomizing steam. Over a wide range of loads, it will hold a constant reduced temperature only 20 ft. downstream from the desuperheater outlet.

Device consists of a self-regulating orifice inside a steel-pipe section. Weighted ball seated in the orifice is held concentrically by Inconel springs. Cooling water enters the orifice seat around the full 360-deg. periphery in response to the action of a temperature controller actuating a diaphragm-operated valve.

Position of the ball varies with the amount of steam flowing. High turbulence in the annular restriction between ball and orifice instantly vaporizes water into steam.

Desuperheater is built for pipeline sizes from 2 to 14 in. and for pressures up to 2,500 psig.—**Copes-Vulcan Div., Blaw-Knox Co., Erie, Pa. 198C**

Refrigerant Condensers

Cut water needs for larger cooling systems.

If you have air conditioning or refrigeration systems, you can beat water supply problems with either of two new condensers.

Using these condensers, refrigerant is cooled by evaporating water from the condensing coils or by passing air over them. They eliminate need for a cooling tower and costly condenser water piping in many "built-up" central systems.

In the evaporative condenser, water is distributed by a new system. A drawer-like pan at the top of the unit receives recirculating water and meters it evenly through orifice holes onto an interceptor screen. Hundreds of holes in the screen break the water into droplets.

Air-cooled units have copper tubes with smooth helical aluminum fins spaced 14/in. for maximum heat transfer in minimum space.

Both units can be installed either inside or outside. Evaporative condenser, in 13 sizes, covers a range from 5-250 ton capacity. Air-cooled unit comes in seven sizes covering a range from two to 38 tons capacity. —**Carrier Corp., Syracuse 1, N. Y. 198D**

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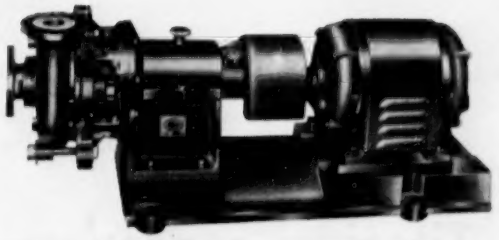

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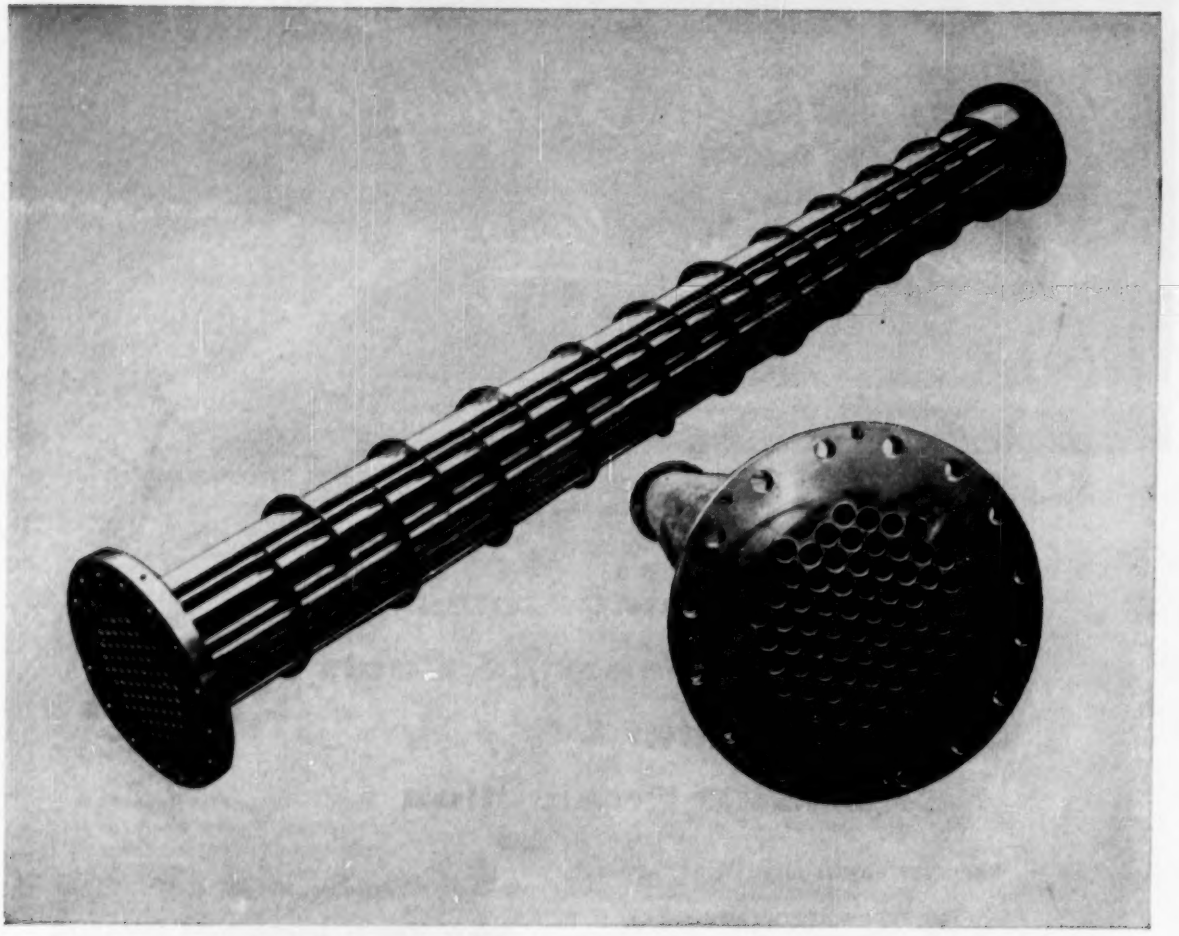

• *The life of this titanium 70-tube condenser assembly, now handling 60% nitric acid at 195° C. and 180 psi, is estimated to exceed 10 years.*

Titanium condenser tubes expected to outlast stainless 30 to 1 handling nitric acid

Corrosive vapors of 60% nitric acid gnawed through an average of three stainless-steel tube bundles a year in a chemical firm's condenser. Maintenance and replacement costs were running as high as $18,000 a year. Then titanium tubes were installed. Based on a service life of 10 years, titanium will save at least $162,000 in maintenance and replacement costs.

life . . . corrosion resistance . . . economy in use

Proven economies

Titanium is actually the *least expensive* metal you can use under many corrosive influences. Titanium withstands conditions that reduce the service life of ordinary metals . . . assures minimum downtime of equipment, fewer replacements.

Titanium offers the economy of long, trouble-free service when exposed to such corrosive environments as:

Salt Water
Marine Atmospheres
Nitric Acid
Wet Chlorine
Chlorinated Organic Compounds
Most Inorganic Chloride Solutions
Molten Sulfur
Chromic Acid
Aqua Regia
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TITANIUM—available today

Titanium is now readily available for non-defense applications. Through research and technical developments by process-equipment manufacturers and mill-product producers in cooperation with Du Pont, standard parts can now be made to specifications. Titanium equipment is already solving severe corrosion problems in a number of industries—chemical, food, pulp, paper and allied industries.

In your process-development work, take full advantage of the corrosion and cavitation resistance, light weight and high strength of titanium . . . important considerations for continuous flow, high temperature and pressure processes. For further information, get in touch with Du Pont. And be sure to mail coupon below for an informative booklet about titanium—its properties and applications. E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, Titanium Market Development Section, Wilmington 98, Del.

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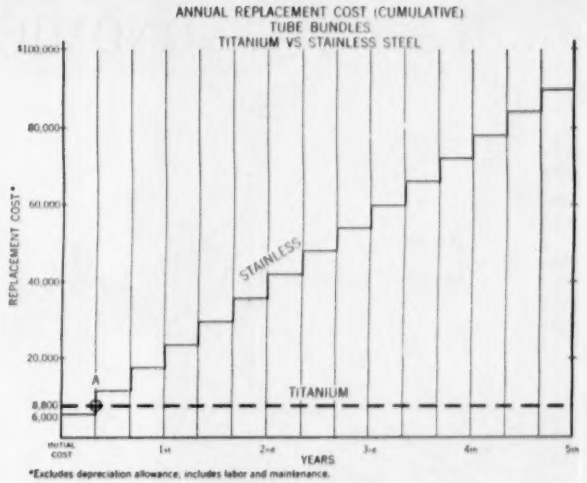
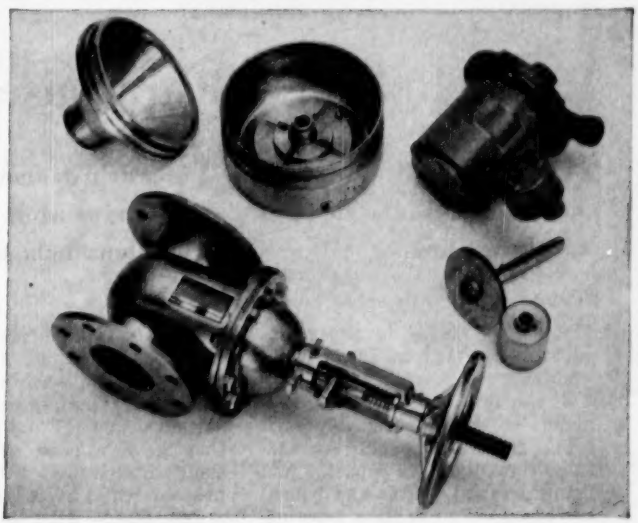


INITIAL AND ANNUAL REPLACEMENT COSTS of titanium and stainless tube bundles are compared above. Initial cost of the titanium tube bundle, shown at left, is $8,800, vs. $6,000 for stainless. But note how the $2,800 difference is absorbed within 4 months of service (Point A). Savings are approximately $81,000 after 5 years . . . $162,000 after 10 years, the expected service life of titanium tubes.



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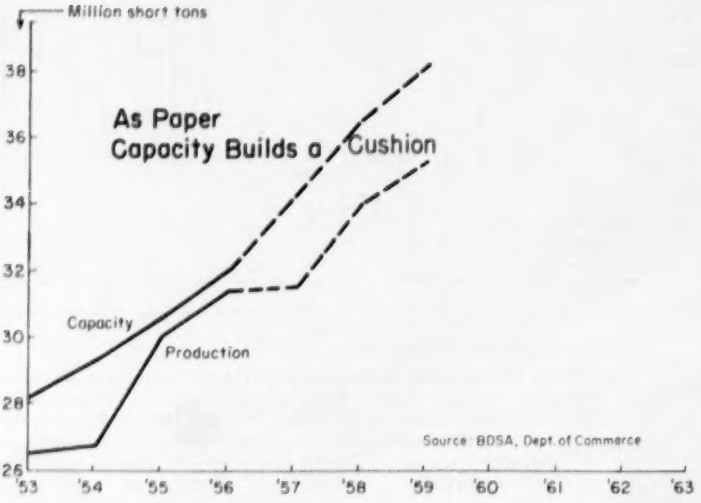
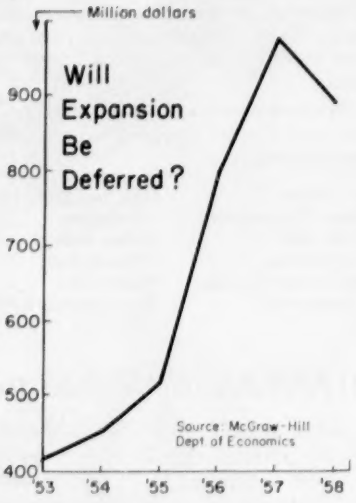
*City*_____ *Zone*_____ *State*_____





Paper Industry Reappraises Supply-Demand

Almost caught short by 1955's avid demands, pulp and paper makers virtually doubled expansion outlays. Now they wonder: Are we spending too much, too fast?

Calvin S. Cronan, Associate Editor

Signs of trends in the pulp, paper and board business have been mixed in recent months. For the first half of 1957, demand softened noticeably—off 3.4% from last year. At the same time, installed capacity for manufacturing paper and board increased. Two million tons of new capacity completed in 1957 will raise total capacity to a 34-million-ton/yr. level, over 90% greater than the 1945 level.

Caught between these countermoving forces, paper industry leaders have reacted in diverging directions. Some, wary of overextended expansion, have ordered slowdowns or stretchouts of programs now underway. Others, viewing the potential market for paper products, still exude optimism. All agree, however, that keener marketing tactics will be needed to hold production up near capacity.

▶ **Inventories Shrink** — Currently, customers get prompt delivery from mills so there is less need for maintaining large stocks on hand. For that reason, they have worked off some of their inventories; this has depressed their volume of new orders placed with the mills.

Figures released by the American Paper and Pulp Association (APPA) for the first six months of 1957 show that total output of paper and paperboard was 15.5 million tons, a drop of 3.4% from the 16.1-million-ton output for the comparable period of 1956. Production of pulp dropped 2% from 11.3 to 11.0 million tons, according to the U. S. Pulp Producers Association, Inc.

While over-all production of paper and paperboard this year fell below the comparable 1956 figure, APPA notes that it exceeded the second half of 1956 by more than 200,000 tons. Should 1957 production continue at the first-half level, APPA estimates total for the year would approximate the record 1956 level of 31.3 million tons. However, the operating ratio (production/capacity) would be lower due to completion of new facilities during the year.

While output of woodpulp was off 2% during the first half, total output for 1957 should be approximately 21.8 million tons, a decrease of 300 thousand tons below 1956. Second half will be better because output of paperboard should pick up now that inventories have adjusted. Expansion of capacity will substantially exceed normal demand rise this year. But demand and capacity should be back in good balance by 1959.

▶ **Look Ahead**—How U. S. demand will grow for paper and board is indicated in a recent report, "Pulp, Paper and Board Supply-Demand," prepared by Business and Defense Services Administration (BDSA), U. S. Dept of Commerce. (*Continued*)

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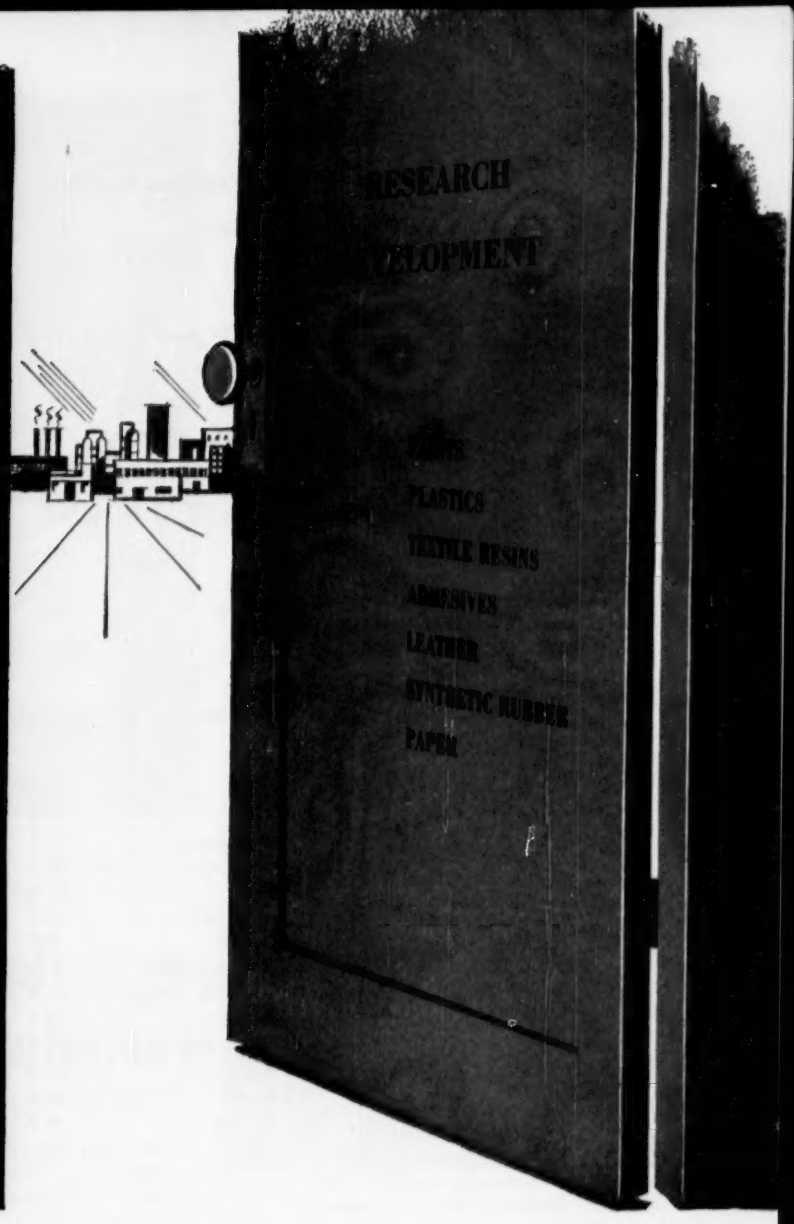

Celanese now offers you a choice of three vinyl monomers for the development of better emulsion paints, adhesives, coatings, finishes, laminates, plastics and synthetic rubbers.

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Write: Celanese Corporation of America, Chemical Division, Dept. 553-K, 180 Madison Avenue, New York 16, N. Y.

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	VINYL ACETATE	VINYL PROPIONATE	METHYL ISOPROPENYL KETONE
	Descriptive Data	Descriptive Data	Descriptive Data
Distillation Range @ 760 mm, °C	71.8-73.0	within 1° (including 94.9)	98 (true boiling point of pure product)
Color APHA, max.	5	10	water-white
Water, % wt., max.	0.15	0.15	1.5
Specific Gravity @ 20°/20°C	0.9330-0.9340	0.9170-9180	0.8555-0.8565
Acidity as acetic acid, % wt., max.	0.02	0.1	—

Celanese CHEMICALS

Information used by BDSA to make its projections was gathered late in 1956. Therefore, the projections do not reflect the more conservative outlook, fostered by drooping sales curves, that is beginning to color some expansion plans.

According to the BDSA report, U. S. committed capacity for paper and board in 1958 is expected to total 36.1 million tons on the historical basis always used heretofore (310-days/yr. operation for all paper except newsprint). On the indicated maximum basis (full, practical, possible output based on an assumed all-out demand and adequate raw materals, labor and operating supplies), it will be 38.8 million tons. Net demand (required U. S. production) will be 34 million tons.

Capacity to produce wood pulp next year is expected to total 28.2 million tons; net demand will be 23.9 tons.

▶**'59 and '65**—For 1959, committed capacity for paper and board should reach 37 million tons, historical basis, or an increase of 16% over 1956. On an indicated maximum basis, committed capacity should reach 39.7 million tons for an increase of 16.5% over 1956.

Domestic woodpulp production capacity is expected to total 28.9 million tons in 1959, or 19.4% more than 1956's 24.2-million-ton capacity.

By 1965, estimated U. S. net demand (domestic demand plus export demand, minus import supply) for paper and board will total 43.8 million tons, an increase of 40% over the 1956 production of 31.3 million tons. Net demand for woodpulp produced in the U. S. is estimated to total 32.4 million tons/yr. by 1965, a 46% rise over the 22.1 million tons produced in 1956.

▶**Revision Upward**—To show that a three-year lapse between projections can alter the outlook considerably, we shall compare BDSA figures with those presented in the report, "America's Demand for Wood 1929-1975," prepared by Stanford Research Institute for Weyerhaeuser Timber Co. in 1954. These comparisons are on the basis of apparent total U. S. consumption (production plus imports, minus exports) rather than net demand.

Chemical Consumption

Consumption by Industries

	June (Final)	July (Est.)
Coal	11.6	11.9
Explosives	9.7	10.5
Fertilizer	56.9	54.4
Glass	27.9	27.6
Iron & steel	17.2	16.3
Leather	4.2	4.1
Paint & varnish	36.8	35.6
Petroleum refining	30.8	31.6
Plastics	23.5	22.2
Pulp & paper	35.9	32.2
Rayon	24.6	25.4
Rubber	6.2	6.0
Textiles	8.9	8.4
Total	294	286

Demand for paper and board projected to 1965 by SRI indicated apparent consumption of 42.7 million tons. Yet only three years later, BDSA projects apparent consumption to arrive at a total figure of 48.6 million tons, or 13.7% greater than the previous forecast.

The same comparison for woodpulp shows BDSA's estimate of 34 million tons to be 20.6% higher than SRI's forecast in 1954.

▶**Pressure Off Newsprint**—Ever since the end of World War II newsprint mills have labored mightily to satisfy mounting demand. By running machines above normal speeds and by pushing expansion of all U. S. facilities, producers boosted output so that supply finally balances demand.

In 1957, the U. S. will consume close to the 7.1 million tons of newsprint used in 1956. Roughly 75% of this tonnage will come from Canada. During 1956 U. S. mills produced 1.6 million tons. By 1959 U. S. mills are expected to produce roughly one-third of total U. S. consumption.

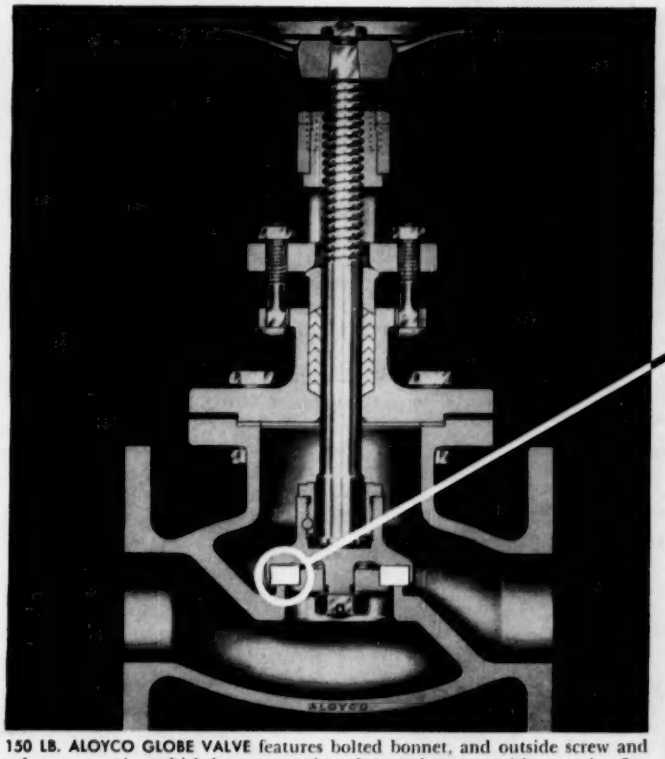
▶**Straws in the Wind**—Turning away from the market place and the capacity-demand picture, we see behind-the-scene activities that bode well for a sound future.

Modern management of timber resources has restored forests so that, today, they are growing more wood than we are using. And industry is increasingly directing effort toward more complete utilization of trees.

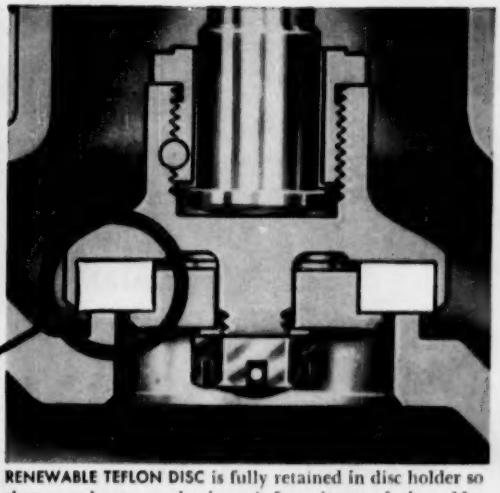
On May 2, 1957, Syracuse University dedicated a $4-million wood products laboratory which will seek to develop greater integration of all forest product industries. Goal will be more efficient and complete utilization of our forest resources.

When one considers that 30% of the tree is wasted during logging, and that up to 50% of the remainder is wasted during pulping, the move toward better utilization would appear economically desireable. If it can be done while reducing labor and achieving a higher degree of continuous operation, benefits may snowball.

▶**Start With the Tree**—Managements of forest product industries recognize more and more these days that the forest is truly a part of the whole manufacturing plant, according to Dr. Lincoln R. Thiesmeyer, president of Pulp and Paper Research Institute of Canada. Pulp, paper, furniture, lumber and the whole array of forest products are manufactured from seeds. Expenditures on forest genetics, silviculture and fire protection can be considered as maintenance and improvement of a major part of the manufacturing plant.



150 LB. ALOYCO GLOBE VALVE features bolted bonnet, and outside screw and yoke construction which keeps stem threads out of contact with corrosive fluids. Two piece gland plates and followers. Sound, heavy section body and bonnet castings. Stainless bolts. Heavy finished stem. Renewable yoke bushing. Flanged or screwed ends.



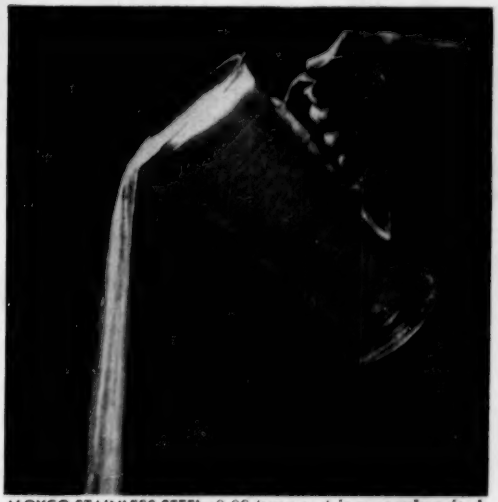
RENEWABLE TEFLON DISC is fully retained in disc holder so that even heavy overloads can't force it out of place. Machined seating surface assures wide full contact with disc and protects against distortion. Teflon V-type chevron packing rings are also used in deep stuffing box.

Tips on selecting valves to combat oxidizing solutions

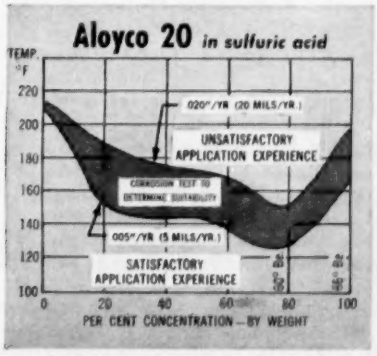
High chromium and chromium-nickel stainless steels are the best alloys for these corrosive applications.

When exposed to oxidizing solutions they form protective films which restrain corrosive attack. Aloyco 18-8S, 18-8S mo and Aloyco 20 are good examples.

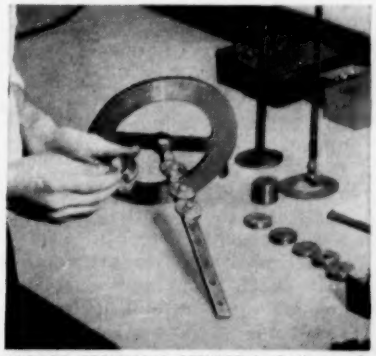
Valves should be constructed so that slight wear or corrosion won't require costly valve replacement. Renewable seats or discs shown above are one answer to this problem. So are deep stuffing boxes and outside screw and yoke construction. And, of course, all valve parts that come in contact with the corrosive fluid should be alloy steels. **Visit us at the Chemical Show Booth #22** 6.18



ALOYCO STAINLESS STEEL 18-8S (type 304) **is expressly suited** for resistance to oxidizing solutions. It also lends itself to innumerable other applications to prevent product contamination or discoloration. In Aloyco 18-8S mo (type 316), molybdenum is added to increase resistance to attack by pitting.

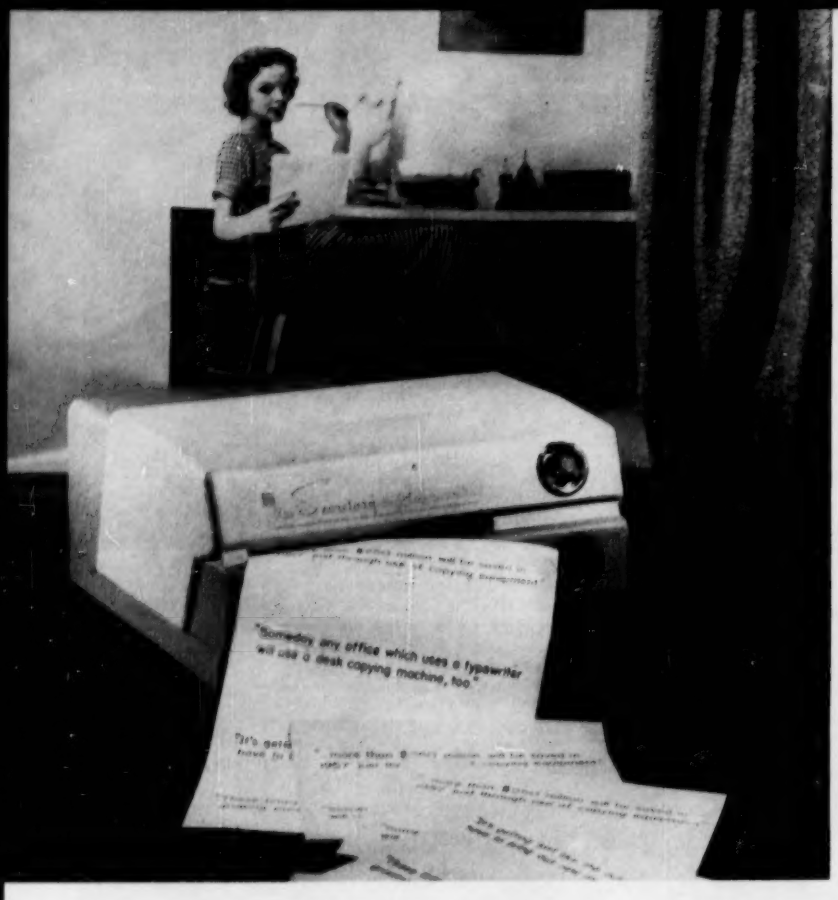


ALOYCO 20 provides a high order of corrosion resistance to a wide range of sulfuric acid concentrations at varied temperatures as indicated by the graph above.



ALOYCO TECHNICAL SERVICE includes engineering counsel, metallurgical assistance and field service. Samples are being prepared for plant line test above.

FOR FURTHER INFORMATION on Aloyco corrosion-resistant valves, write to Alloy Steel Products Company, 1301 West Elizabeth Avenue, Linden, New Jersey.



Copiers Cope With Paper Work

Smothered by a postwar avalanche of records in triplicate (at least) firms are looking to the new and handy copying machines for relief.

Frances Arne, Assistant Editor

Set off by World War II, a boom in tools for reproduction of paper work—from engineering drawings to office memos—has been even more volatile than the national production boom on which it is based.

Except for the old ferro-prussiate blueprint process, all copying processes—those best suited to make one to ten copies—have either been launched or picked up their real momentum in the past ten years. Except for a few still in the development stage, all depend in whole or in part on chemical action for their printing effect.

Producers of all types of copying equipment and supplies should have sales of $150 million this year, according to American Photocopy Equipment Co. (Apeco). This is significantly better than last year's $134 million and way, way above the $40-million level of 1952.

Apeco counts on a 25-30% hike in its own copying machine sales this year. General Aniline & Film's Ozalid Div. reports a 10% year-to-year gain in volume. Haloid Co. is budgeting a 15% rise in copying sales.

Bulking large in this sales picture is the steadily growing bread-and-butter-supplies business involved. It's estimated that each copying machine gobbles up its original price in paper and chemicals each year under normal office use.

Another good indicator of the copying field's overall growth is diazo-based reproduction which now claims three-quarters of all technical prints (engineering drawings, technical specifications). Diazotype paper mill production rose from 366 million sq. yd. in 1951 to 609 million sq. yd. (45,700 tons) in 1956. A further measure of success: Sales moved from $9 million in 1947 to $27 million in 1954.

And it takes 2-5 gm. of chemicals—diazo salts, coupling compounds, stabilizers, acids—per sq. yd. of paper to supply diazo paper process demands.

Silver halide paper designed for line reproduction, photocopying and recording has come along fast, too. Sales rose from 32 million sq. yd., worth $11.5 million, in 1947 to 79 million sq. yd., worth $35.2 million, in 1954.

Copying processes represent considerable chemical engineering ingenuity and are inviting even more. Printing through the action of light, heat and/or electricity on chemicals coated onto paper, cloth, plastic or other base, machines have been in the vanguard of the graphic arts field. Unlike conventional long-run printing or even shorter-run duplicating equipment (ten to several hundred copies), they represent a relatively casual investment. This means quicker turnover, a more pressing competitive situation with its attendant need for both technical and market research and development.

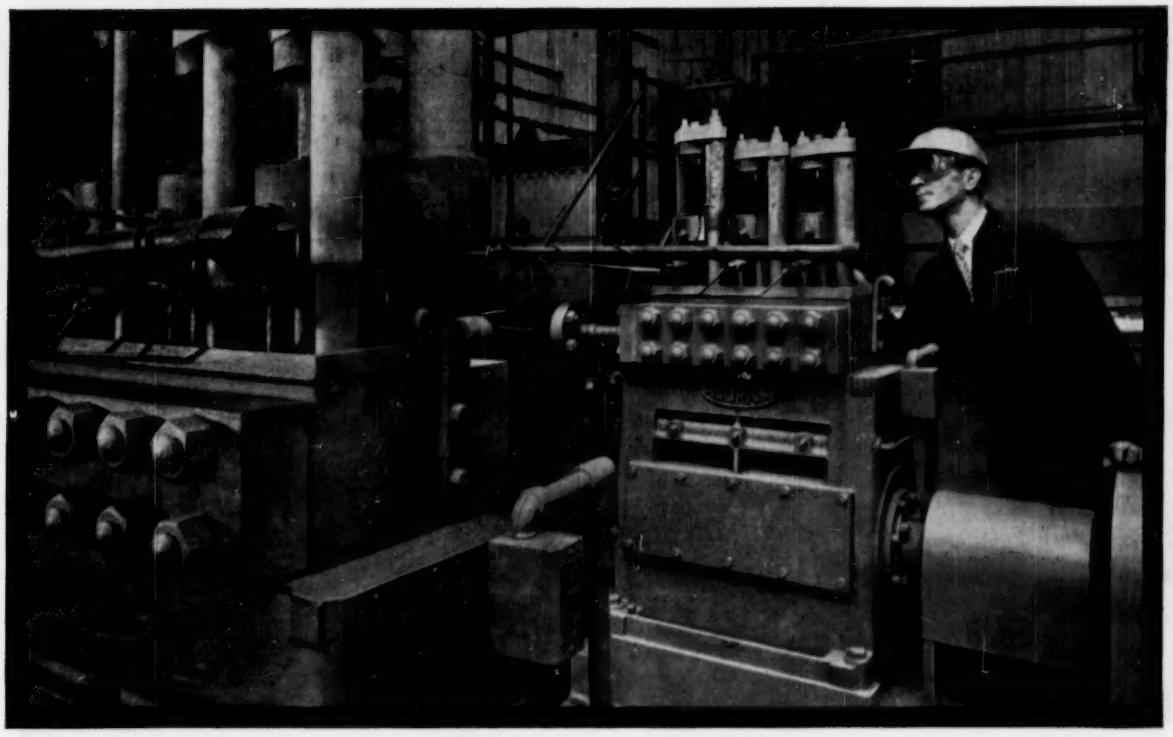
▶ **Electrostatic Images**—Processes based on electrostatics, though still largely in the development stage, are the ones generally expected to inherit the earth. Perhaps most prominent among these is the RCA-developed Electrofax process. Licensed for specific adaptation by many big names in the copying field, including Ozalid, Remington Rand, Minnesota Mining & Manufacturing Co. and American Photocopy Equipment Co., it is expected to start giving established processes a run for their money in about two years.

In this system, paper is coated with a photo-conductive material, such as zinc oxide, plus a resin binder with a high dielectric strength, such as some

SPENCER CHEMICAL CO. UNRAVELS KNOTTY PROBLEM:

Maintaining a controlled flow of liquid ammonia at high pressures, 24 hours a day.

At the Vicksburg, Miss. plant of Spencer Chemical Company, ammonia production demands two things of pumps: (1) 24-hour, 7-day-week operation and (2) continuous flow of controlled volumes of liquid ammonia at high pressure.



How Spencer licked the problem: When Spencer began outlining construction plans in 1951, company engineers specified two Aldrich Direct Flow, ¾" x 3" stroke Triplex Pumps. These were scheduled to be used for alternate 30-day periods. According to company spokesmen, nearly four years of service have proved these pumps to be efficient and capable of durable service.

Results: Dependability and freedom from trouble in all phases of operation. The Vicksburg Works Maintenance Superintendent tells us: "The Aldrich Pump is an excellent unit. Valve life is excellent and packing life exceptionally good."

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Copying Processes: How Fast, How Much?

Process	Speed	Estimated Cost per Copy
Diazo	200 letter-size copies/hr.; copy up to 54 in. wide at 20–30 ft./min.	¾–1¢ (letter size)
Facsimile	3 min./copy	4½¢ (single)
Photocopy	1–2 copies/min.	8–10¢
Smokeprinting	60 copies/min.	1/10¢
Thermo-Fax	4–15 copies/min.	4½–5¢
Verifax	3 copies/min.; single copies, 50 sec.	9–10¢ (single); 3–4¢ (runs of three)
Xerography	3 min./single copy	9¢ (single)

of the silicone resins. It represents a big potential chemical market, requiring 18-36 gm./sq. yd. of paper.

Coated sheet is subjected to a corona discharge which impinges an electrostatic charge over the surface. Charged surface is exposed to a light pattern corresponding to the image to be reproduced, either in an ordinary camera or by contact with a positive. Charge drains away in proportion to intensity of the light incident on a given portion of the surface.

Latent image is developed by means of a "magnetic brush" consisting of a thermoplastic resin powder carried on a brush of iron filings. Image is then heat treated and fixed to the original sheet of paper. It need not be transferred to a separate sheet.

Another electrostatic process has already had considerable commercial success, particularly in the field of multiple reproduction, i.e. 100 or more copies. Called Xerox, it is controlled by the Haloid Co. It differs from the RCA technique in that it does not use a specially coated paper, but relies instead on the photo-conductive properties of selenium-coated metal plate from which the image is transferred to the final base material.

▶ **Where There's Smoke** — Smokeprinting, still under the developmental wing of Standard Register Co., has also stirred up considerable excitement in the electrostatic copying field. A mist or smoke of electrically charged ink is passed over an image which carries an opposite electrical charge, and, being attracted to it, adheres to create a printed copy.

As for currently entrenched processes, the field is pretty well enveloped by two large groups: processes based on diazo chemistry and those based on silver halide chemistry. One other process, Thermo-Fax, belonging to Minnesota Mining & Mfg. and uniquely based on a heat-sensitive coated paper, has made remarkable commercial strides in the few years of its existence.

▶ **Diazo Duplicates**—Two types of diazo reproduction are in wide use in this country. In one method, typified by processes of General Aniline & Film's Ozalid Div. and Tecnifax Co., paper is coated with a solution of diazo salt, a coupler, and an organic acid, such as citric, to restrain coupling.

Exposure to light destroys the diazo; the portion blocked out by lines on the original is treated with ammonia fumes, the acids are neutralized, and coupling takes place.

The moist processes, of which the Bruning system is an example, require paper treated with diazo compounds, as well as stabilizers. After the latent image has been formed, the paper is passed over a moist roller coated with a coupling compound, which unites with the undestroyed diazo.

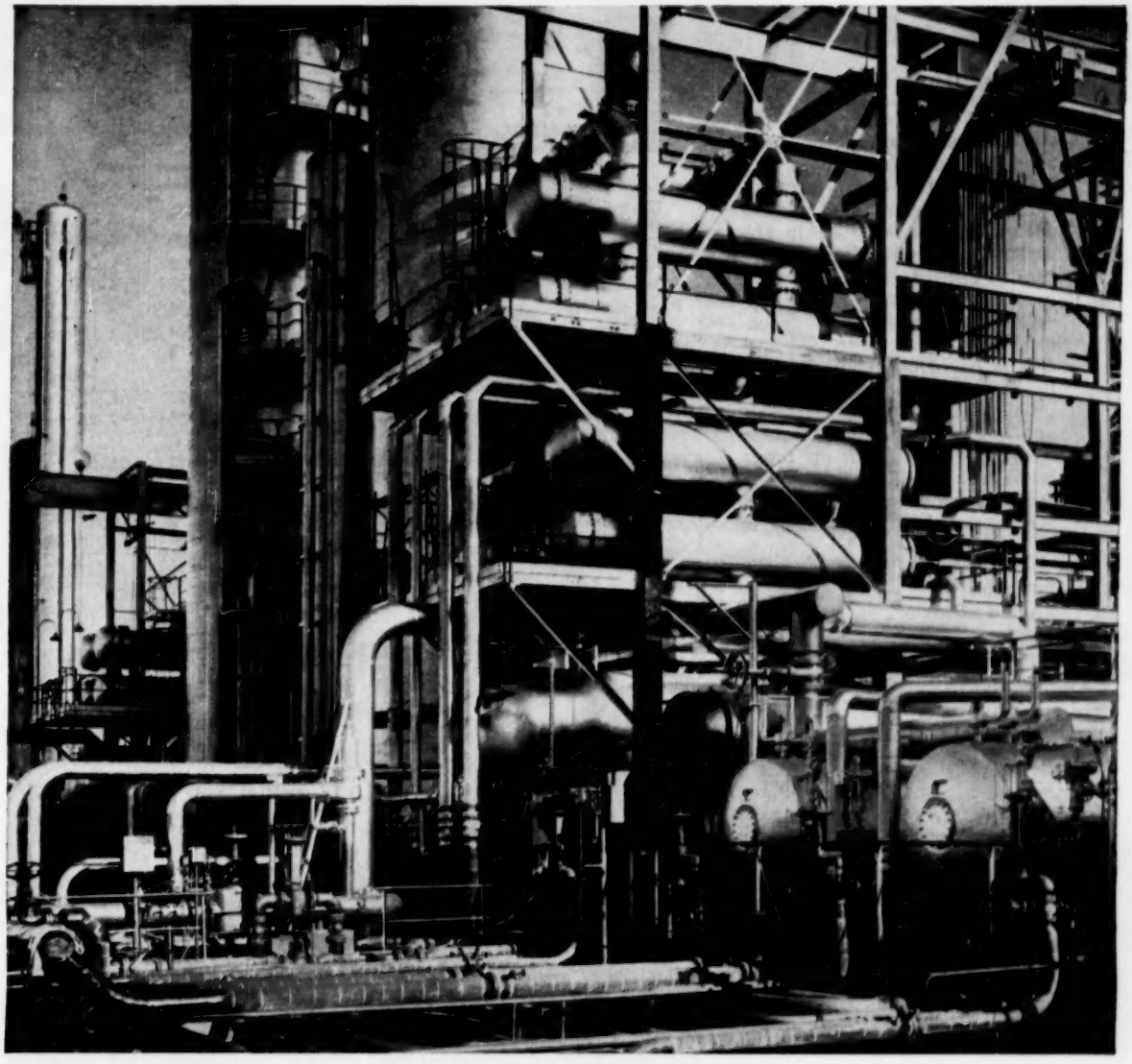
▶ **Silver Transfer** — In the silver-halide group, dry photographic transfer processes—which made their commercial debut around 1952—have taken over a large share of nonspecialist-operated copying chores.

There are two major divisions in transfer processing. Soft gelatin transfer, typified by Eastman Kodak's Verifax copier, is a physical or mechanical technique, can produce several copies per exposure. Diffusion transfer, typified by American Photo Equipment's Apeco, is a chemical transfer (similar to Land Polaroid's picture-in-a-camera), can usually produce only one copy per exposure.

Both processes utilize exposure to light by the reflex method. The principal difference between the two is that in physical (gelatin) transfer, copies are formed by the deposit of gelatin-containing emulsion on unsensitized copy. In diffusion transfer, copies are formed by the diffusion of silver salt grains from the negative to the positive paper where they are developed to form an image. Both processes produce a nominally dry copy, although both employ a liquid chemical solution to develop or activate the negative or matrix.

Thermo-Fax is the only completely dry, one-step copying process. A wax-like, opaque chemical is sandwiched between a black paper and a transparent layer. Exposure is made by infrared rays through the original, the black or image layers of which transmit the heat better than the nonimage areas. This heat is sufficient to melt the white, opaque wax-like compound, which becomes transparent and permits the black back coating to show through.

▶ **Standbys and Oddities**—Old chemical standbys for these established processes — citric acid, thiourea, zinc chloride and the more or less conventional light-sensitive diazos such as the derivatives of *p*-phenylenediamine—are made by a small number of chemical firms specializing in such synthetic work. In addition, however, there are quite a few compounds which might best be classed as chemical oddities and which are made in many hundreds, or perhaps thousands, of pounds for spe-



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cialty diazotype products. Some of these materials range into rather unusual price brackets—as high as $30/lb. or more.

▶ **Ease and Speed**—In general, primary impetus for technical advances appears to be in the direction of increasing simplicity and speed in operation, with less emphasis on cost and excellence of reproduction. Thermo-Fax's quick and decided success is based on simplicity, and in spite of compromise with product quality (copy is legible but not as attractive as most competitors; it picks up fewer colors).

But much more of the research aims at improvement in all directions with no compromises. Whereas established processes have speeds and costs around 1-5 copies/min. and 1-5¢/copy (see table, p. 208) developmental processes have made some progress toward producing an excellent reproduction at a fraction of a cent in a fraction of a second, with push-button controls.

▶ **System Copying, Too**—Some of the field's developments have already overflowed the bounds of simple copying. Dovetailed to other machines such as multiple-duplicating units and electronic computers, they have become important links in complex automated systems. These systems bear the brunt of the work for whole departments for business and industry—accounting, insurance, statistics. Diazo processes are particularly well suited to copying chores within a controlled system of this kind. Forte of Thermo-Fax and Verifax is "random" copying.

For some of the processes, particularly those based on electrostatics, copying may turn out to be an excellent, but relatively confining, commercial proving ground. Their impact may affect the whole of the graphic-arts field, may even threaten conventional printing with its centuries-old roots in mechanical application of ink to paper.

PETROCHEMICALS

. . . A review and forecast of trends . . . NEXT MONTH

Electroprocessing Industry Calls for More Kilowatts

Electroproduct	Production (Thousand Tons) 1960	1975	Power Needed (Thousand Kw.) 1960	1975
Aluminum ingot	2,300	5,500	4,520	10,800
Magnesium ingot	110	500	228[1]	1,040[1]
Titanium sponge	80	1,100	336[2]	4,210[2]
Fused alumina	250	375	84	121
Silicon carbide	100	175	104	181
Calcium carbide	1,100	2,000	410	745
Chlorine	5,000	12,000	1,670	4,010
Phosphorus	400	700	625	1,095
Ferroalloys	2,700	4,000	1,950[3]	2,890[3]
Total Power			9,927	25,092

[1]For electrolytic or silico-thermal process. [2]Including regeneration of magnesium or sodium and chlorine. [3]Estimated average power requirement.

Electroprocess Power Hunger

Diversion of electroprocessing expansion from hydroelectric sites will end if the industry's special power demands make it turn again to the Northwest.

"Electroprocess industry development in the Pacific Northwest and Alaska—although at low ebb at this time—will be resumed on a major scale during the next ten years and perhaps much sooner." These words are from a paper delivered this past summer by Ivan Bloch and John Davidson at a Seattle meeting of the American Institute of Chemical Engineers.

Bloch and Davidson base their case on these beliefs:

• That nine of the major electroprocess industries will require a total power capacity in 1960 of nearly ten million kw., and an enormous block of 25 million kw. just 15 years later—nearly 10% of the nation's predicted power needs. (See chart above.) And the list doesn't include other important electroproducts like electric steel, electromanganese and silicon metals.

• That existing power capacity (90% hydroelectric) in the Pacific Northwest—8.4 million kw. in 1956—will be enhanced by 10.6 million kw. of hydroelectric capacity now in various stages of consideration. (Only 3.1 million kw. of capacity, however, is actually under construction.)

• That Alaska's total hydropotential is at least 16 million kw.

• That alternatives to hydroelectric energy for electroprocessing—power generated by Gulf Coast natural gas, Texas lignite, or Ohio Valley and Rocky Mountain coal—have serious drawbacks which "tend to limit development for the immediate and long-range future."

Assuming Bloch and Davidson are correct in these beliefs, getting the most out of our Pacific Northwest and Alaska won't be, and hasn't been, easy, what with international boundaries, politics of public vs. private power, competitive demands for energy and power-industry prejudices to mess up the works.

The authors know this, but maintain "There are no alternatives for the expansion of the industry."

Take the tedium out of correlation studies with this powerful electronic computer

ROYAL PRECISION LGP-30

Large capacity . . . easily programmed and operated . . . mobile . . . low in cost

Compact, simple to use . . . Royal Precision LGP-30 brings high-speed electronic computation *right to your desk* . . . relieves you of the tedium of statistical analysis in such areas as research and product development, quality control and process control. And at the lowest cost ever for a complete computer system!

Faster answers; unusual capacity. Used wherever *you* want it, LGP-30 operates from any conventional wall outlet, is self-cooled. Providing fast, effortless answers for all types of statistical studies—correlations, analysis of variance, regression analysis, curve-fitting – LGP-30 gives you speed and memory (4096 words) comparable to computers many times its size and cost . . . stored-program operation for complete flexibility. Result: you save valuable time . . . handle more assignments . . . go forward to truly *creative* work.

Easy to operate and program. Controls have been so thoroughly simplified, LGP-30 may be operated with only minimum computer experience. Answers are printed out directly . . . do not require deciphering. Programming is easily learned. A library of sub-routines, plus programs for a wide variety of applications (including Box technique for experimental design), are available.

Wide range; exceptional value. The most powerful computer of its size yet developed, LGP-30 is the greatest value in today's market. Remarkably small initial investment is combined with low operating and maintenance costs. Service facilities are available coast-to-coast.

For further information and specifications, write Royal McBee Corporation, Data Processing Equipment Division, Port Chester, N. Y.

ROYAL McBEE

WORLD'S LARGEST MANUFACTURER OF TYPEWRITERS AND MAKER OF DATA PROCESSING EQUIPMENT

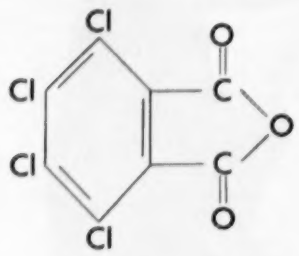
BRIEFS FOR BUYERS

about Plastics Building Block • New Intermediates • Caustic Soda • Caustic Potash •

Heat-stable building block makes plastics resist fire

If you want to build heat stability into a plastic product, take a good look at this molecule of *tetrachlorophthalic anhydride*, trade-named NIAGATHAL®.

Nearly half its weight is concentrated in four chlorine atoms, providing a very stable compound that won't melt unless you heat it to 254°-255° C.



Translate these properties to read "fire resistance," "heat resistance," "good electrical qualities"—if, for example, you're adding NIAGATHAL to a polyester resin.

It's most effective in polyesters containing pigment or other filler—lets you load as much as 22% stable chlorine into such resins. When you do this, you come up with a polyester that's inherently, permanently self-extinguishing.

To help you evaluate this chemical, we've put together, in bulletin form, several published papers reviewing its properties and solubilities, its many reactions and suggested uses, as well as uses of derived compounds. To get a copy, just check the coupon for *Bulletin 46*.

If you'd like an evaluation sample of NIAGATHAL, *please write on your business letterhead.*

Are you getting the best buy in chlorinated organics?

If you're buying or using chlorinated organics, it may pay you to ask yourself the following questions:

1. Are you making chlorinated intermediates yourself that you could *buy* more cheaply from Hooker?
2. Are you buying *more than one* chlorinated compound, from different sources, that you could buy at a saving from *one* specialized source?
3. Would a chlorinated organic of higher purity than you're getting now improve your processing?

Why not call on your Hooker salesman to help you arrive at the answers?

Monochlorobenzene is an example of hundreds of chlorinated organics we've made. This product is typically 99.5% pure, as determined cryoscopically. It's so free from higher-boiling fractions that after drying, it distills within 1°C. It's used widely as an intermediate for insecticides, dyestuffs, pharmaceuticals, perfumes, and other organic chemicals; as a solvent for paints, varnishes, lacquers. You can have it delivered in 55-gallon steel drums or in tank cars.

Some others:

ortho-Dichlorobenzene, Tech. Contains 85 to 87% *ortho-*, 55-gal. drums, tank cars.

para-Dichlorobenzene, 100% *para-*, available in 7 mesh sizes, fiber drums.

Trichlorobenzene, Tech. Mixture of 1,2,4- and 1,2,3-trichlorobenzenes, the 1,2,4- predominating, 55-gal. drums, tank cars.

1,2,4,5-Tetrachlorobenzene, Solid; contains 65.7% chlorine, fiber drums.

Sulfur chlorides for low-cost chlorination

As chlorinating agents, the sulfur chlorides provide you with low-priced sources of chlorine which are relatively easy to handle and store.

Sulfur monochloride, S_2Cl_2, is a definite compound with well-defined properties. This is not true of *sulfur dichloride*, SCl_2. In chlorination reactions, sulfur dichloride may be considered the equivalent of chlorine dissolved in sulfur monochloride.

In general, you can use sulfur monochloride and chlorine wherever sulfur dichloride is required. There are certain advantages in doing so, since sulfur monochloride can be purified by distillation and stored without gas pressure developing in the container.

Hooker sulfur monochloride is a yellow to slightly reddish heavy liquid containing 52.0 to 52.5% chlorine. Hooker sulfur dichloride, a brownish-red liquid, contains 66% min. chlorine.

For some helpful tips on chlorination with these and other Hooker chlorinating agents (chlorine, sulfuryl chloride, thionyl chloride, hydrogen chloride), check the coupon for Bulletin 328-A, *Hooker Chlorinating Agents*. You can use the coupon also to request technical data sheets on any of these chemicals.

That new intermediate you need may be hiding in our woodpile

In this complex age, it can happen that the new intermediate you're seeking is closer than you think—cheaper, too.

Looking for something that has "never been made before?" Maybe it's in production already–for another use. Maybe you can get it in tank-car quantities.

Let's say you're on the trail of a new polymerization modifier. Your preliminary work indicates a mercaptan structure is desirable. It should have a freezing point below 0°C, a boiling range over 100°C. It should be a mobile liquid, light in color and with little or no odor.

Well, one compound that meets these requirements is our *lauryl mercaptan*—$C_{12.4}H_{25.7}SH$ (average). A strong advantage of lauryl mercaptan is *availability*.

This product is one of many that helped, in a modest way, to make wartime synthetic rubber more plentiful. It's still around—still being used as a modifier in the synthetic rubber "hot" process. We can ship it in carboys, drums, or by the tank car.

This is just one example of how checking with us might save you a costly development program, next time you need something new.

Chlorinated Organics • Chlorinating, Sulfonating Agents

Inert Lubricants • Phosphoric Anhydride

Wet or dry

How do you like your KOH?

If you're one of the relatively few people who prefer caustic potash in the solid state, we can provide you with any of these *seven* forms, all at 90% KOH:

1. Solid
2. Flake
3. Granular
4. Walnut
5. Broken
6. Powder
7. Crushed

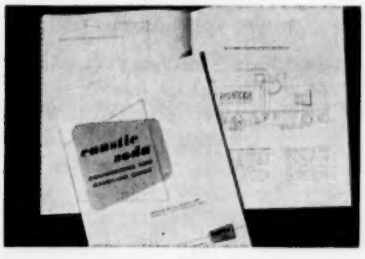
If one of these won't do, we can ship you 85%-strength KOH of even higher purity, in *flake* or *solid* form.

If you prefer your caustic potash *liquid* (it's generally cheaper and easier to handle), you can get it from us in concentrations between 45% and 52%, delivered in 55-gallon drums, tank cars of 4,000-, 6,000-, 8,000-, or 10,000-gallon capacity—or in duplex tank cars holding 3,000 gallons per compartment.

Is all this fuss worth while over a specialty alkali like caustic potash?

Well, our customers tell us it is. And they buy, under the NIALK® label, about half the caustic potash sold in this country.

We hope you'll think so, too.



40-page manual tells how to handle caustic soda

Written for engineers, this 40-page Hooker manual sums up newest techniques for handling and storage of liquid caustic soda.

Contents include detailed diagrams of equipment; a section on materials of construction; recommendations for unloading, diluting, piping, and storage; and a section on safety precautions and first aid.

For a copy, check the coupon for Hooker Bulletin 102, *Caustic Soda Engineering and Handling Guide.*

You can't burn this grease

You may at first be discouraged at the things you *can't* do to this product. But therein lies its value.

Besides being completely nonflammable, it won't break down in the presence of oxygen, hydrogen peroxide, concentrated mineral acids and alkalies. It's unaffected by heat up to 300° C; is stable at very low temperatures, too; is odorless and nontoxic.

What's its name? FLUOROLUBE®. It's a high-density addition polymer of trifluorovinyl chloride. The basic polymer can be fractionated into many grades, ranging from low-viscosity colorless oils through heavy oils to opaque greases. All have excellent lubricating qualities.

Fluorine and chlorine, accounting for nearly 80% of the molecule, contribute to the high densities and complete fire safety of FLUOROLUBES.

What *can* you do with them? Some suggestions: lubricate ultraprecision instruments; seal pumps, valves, pipe joints in equipment handling oxygen, hydrogen peroxide, nitric acid, and other corrosives; lubricate PVC fittings, plug cocks, vacuum pumps in highly corrosive service.

You'll find other ideas on use, plus specifications and typical properties, in a data file on FLUOROLUBES which you can get by checking the coupon.

What do you want to dehydrate?

If you have a *drying* problem, don't overlook *phosphoric anhydride*, P_2O_5. This OLDBURY product is one of the strongest known desiccants.

A white fluffy powder assaying 98% min. P_2O_5, it contains no sulfate. This is an important advantage in one of its major uses—as a condensing agent in making clear methacrylate resins.

If you're interested in phosphoric anhydride for a present or a potential use, just check the coupon for more complete information.

for your file . . . new data on:

Sodium chlorate, $NaClO_3$ (OLDBURY®)
Potassium chlorate, $KClO_3$ (OLDBURY)

New data sheets on these two chemicals have been released. For copies, check the coupon on this page.

For more information on chemicals mentioned on this page, check here:

- ☐ NIAGATHAL (Tetrachlorophthalic Anhydride)
- ☐ Monochlorobenzene
- ☐ *ortho*-Dichlorobenzene, Tech.
- ☐ *para*-Dichlorobenzene
- ☐ Trichlorobenzene, Tech.
- ☐ 1,2,4,5-Tetrachlorobenzene
- ☐ Sulfur Monochloride
- ☐ Sulfur Dichloride
- ☐ Lauryl Mercaptan
- ☐ Caustic Potash
- ☐ Bulletin 102, *Caustic Soda Engineering and Handling Guide*
- ☐ FLUOROLUBES
- ☐ Phosphoric Anhydride
- ☐ Sodium Chlorate
- ☐ Potassium Chlorate
- ☐ New list of products—Bulletin 100-A

Clip and mail to us with your name, title, and company address. *(When requesting samples, please use business letterhead.)*

HOOKER ELECTROCHEMICAL COMPANY
411 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

Niagara Falls Tacoma Montague, Mich. New York Chicago
Los Angeles Philadelphia Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B. C.

HOOKER CHEMICALS PLASTICS

When you consider

COST

also consider

PERFORMANCE

BE SURE—in your estimate of drying equipment costs—TO INCLUDE:

UNIFORMITY OF PRODUCT

•

LONGER EQUIPMENT LIFE

•

LESS OPERATING DOWNTIME

•

HIGHER PRODUCTIVITY

•

MANUFACTURER'S SERVICE TO YOU

•

LOW MAINTENANCE COSTS

BE SURE to consider Proctor too, when you plan a dryer installation.

Then—buy where you find the highest ratio of performance to cost.

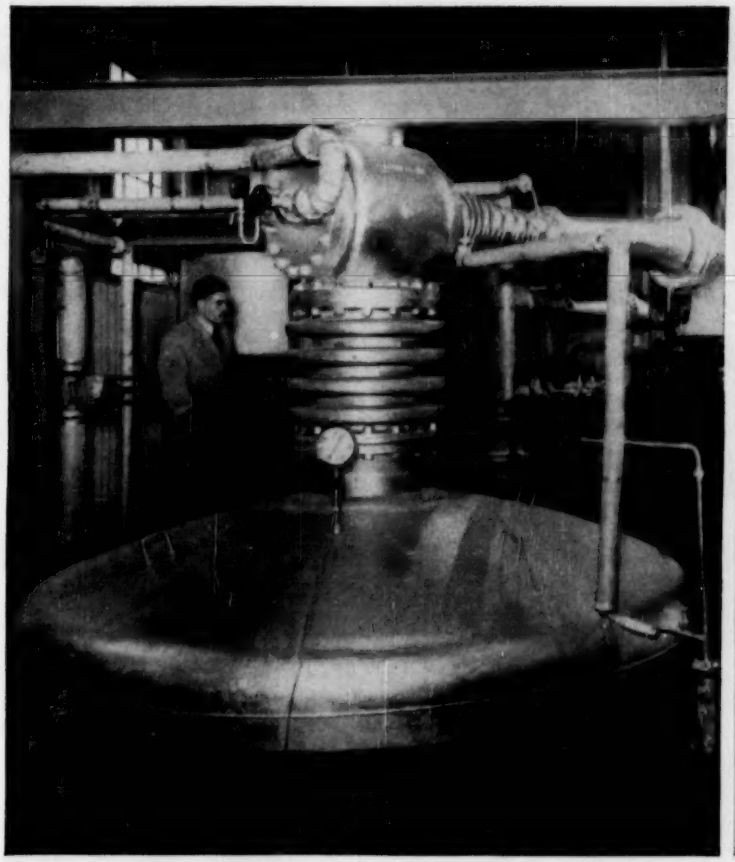
We believe you will do as hundreds of others have—specify Proctor.

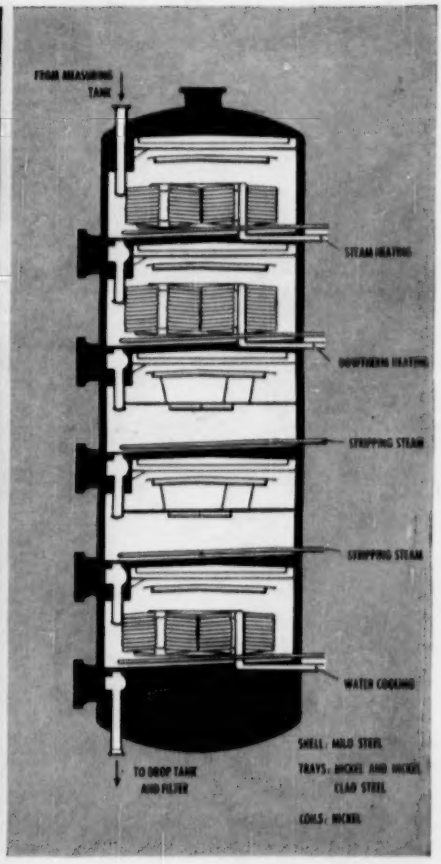
Proctor

PROCTOR & SCHWARTZ, INC.

Philadelphia 20, Pa.

Manufacturers of Industrial Drying Equipment and Textile Machinery.





Nickel protects purity of vegetable oils during deodorization in these Southern Oils, Ltd. stills. Diagram shows general arrangement and where nickel is used in the units. Fabricator: Rose, Downs & Thompson, Ltd., Hull, England. Design: Girdler Corporation of America.

Processed in nickel, foods and other organics stay fresh longer

One of the most baffling problems in converting and purifying vegetable oils for human consumption is presented by the equipment itself.

Even minor corrosion of this equipment may build up metallic concentrations in the product sufficient to create new threats to purity. High process temperatures amplify the danger.

The harm shows up in storage. Early rancidity. Undesirable color changes.

Processing in nickel equipment provides double protection

Nickel acts in two ways to prevent trouble of this kind.

1. Nickel resists corrosion by fatty acids and other corrosives in vegetable oils and many foods . . . even at elevated process temperatures. With nickel, metallic concentrations usually stay far *below* the harmful level.
2. Nickel doesn't promote rancidity and color changes. It's non-toxic, too.

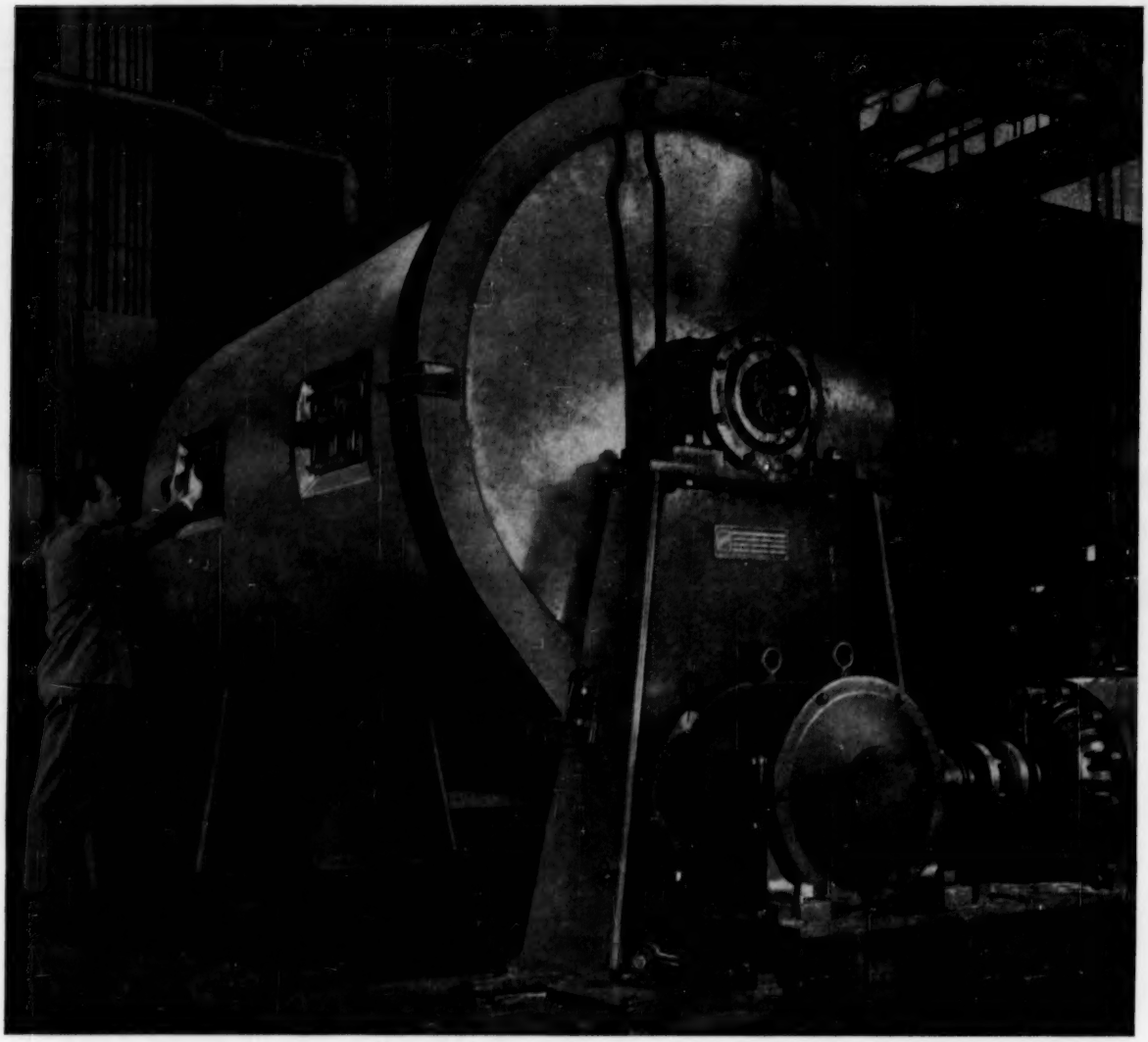
Southern Oils, Ltd. (Manchester, England) is one of many companies that takes advantage of these properties to insure high product purity. In their vegetable oil deodorizing stills, for example, (see photo and drawing) tray sides are nickel-clad steel plate, tray base and heating coils pure nickel. So are many of the auxiliary fittings . . . tray tops, liquid level probes, etc.

Despite process temperatures that run as high as 475-480°F., Southern Oils' storage experience with the product has been excellent.

To learn what many food processors are doing to solve their corrosion and purity problems, send for a copy of Inco's Technical Bulletin T-28. It's yours for the asking. And if you have a specific question, why not jot it down? We'll do our best to help you.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel**—for purity



Bigger process equipment helps fight the profit squeeze

The economic squeeze play, which finds many producers caught between rising costs and shorter profit margins, is likely to continue through 1957. In the process industries, the gap can often be widened by increasing productivity per machine hour. Dravo large scale or special purpose process equipment is ideally suited to this job.

The king size ball mill shown above is a case in point. Designed to meet specific grinding and batch size requirements, it is constructed of stainless steel. All the internal welds are ground flush and the interior polished to a smooth finish. Internal corners are provided with fillets to facilitate cleaning between batches. This large ball mill is helping the owner to step up production rate.

This type of equipment has helped many processors lick production problems by reducing labor cost. And frequently, by bringing design into complete harmony with process requirements, special purpose equipment can achieve astonishing cost reductions.

Take advantage of the engineering skill and fabricating facilities which Dravo can bring to bear on process equipment problems. Write to Dravo Corporation, Pittsburgh 25, Pa.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

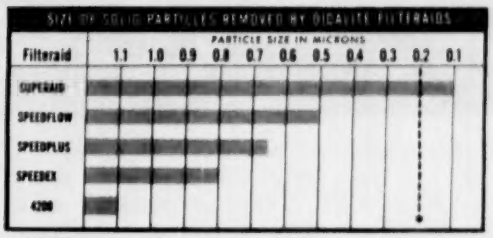
It may pay you to read this

When anything has been long established – as have the advantages and properties of Dicalite Filteraids – there is a tendency for some of the details to slip the mind. Hence, this two-minute reminder may be of very present value on your problems of today or tomorrow.

Dependable GLC GREAT LAKES **Dicalite**® DIATOMACEOUS MATERIALS

Sharp Filtration

As the chart shows, Dicalite Filteraids can remove *all* unwanted particulates, even those down in the sub-micron range, to give unsurpassed clarity of filtrate.



*0.2 MICRON – Theoretical limit of resolution of optical microscope. Few microscopes achieve it.
80.0 MICRONS – Smallest particle size visible to the unaided eye at 10" distance.

Fast Flowrates

Since a Dicalite filtercake is 85 to 90% voids – only 10 to 15% solids, and relatively incompressible – flowrates are fast for full production.

Full Range of Grades

By selection of the correct Dicalite Filteraid (there are 9 grades, with relative flowrates from 1 to 20) any process liquor may be economically filtered to required clarity with optimum throughput.

Chemically and Physically Stable

Being practically pure SiO_2, processed from high-grade crude diatomite, Dicalite Filteraids are inert in acid and aqueous solutions.

Uniform Quality

All Dicalite Filteraids are highest quality, and the industry's most exacting quality-control processing maintains the particle size range and distribution of every grade dependably uniform, lot after lot.

If you have not completely investigated the advantages of Dicalite in your processing, write for Dicalite Bulletin B-13, which discusses the practical applications of Dicalite Filteraids in processing.

DICALITE DEPARTMENT • Great Lakes Carbon Corp.
612 South Flower Street • Los Angeles 17, California

Pump acids through it...alkalis...then solvents

It can't corrode because it's PYREX® pipe

The pipe you can see through resists more corrosives than any other pipe, yet actually costs you less installed.

Of all the chemicals you might run through PYREX Pipe, only hydrofluoric acid and hot, concentrated alkalis above pH 12 can corrode it.

Yet this pipe actually costs you less after all installation costs are considered, and it gives you the benefit of these other properties:

You can see through it. You can inspect the condition and cleanliness of this pipe visually. Should there be a blocking, you can locate it exactly, determine its nature, remove only the blocked section to clear the line.

You can run liquids hot. PYREX Pipe takes temperatures up to 450° F. For a 100° F. change in temperature a 100-foot section contracts or expands a mere 0.22 inches; so there's no chance of cracking or buckling when properly supported.

No scale build-up. Smoother by far than the most highly polished metal, the inner surface of PYREX Pipe usually eliminates scale build-up, *often allowing the use of smaller diameters.* Should scale develop, it's more easily cleaned off glass.

Costs Less. PYREX Pipe is itself competitively priced. Real savings begin when you start to install it. Because it's light, it goes up faster. *Ten*-foot sections of PYREX Pipe weigh less than the average *four*-foot sections of metal pipe.

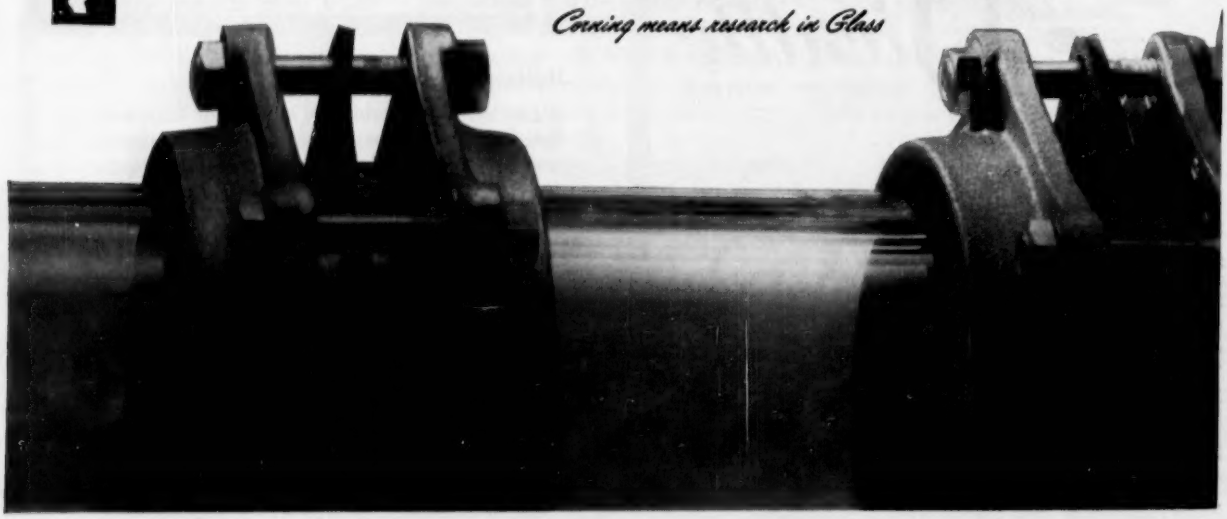
You use only half the hangers, half the connections with the 10-foot lengths. You need no costly expansion joints.

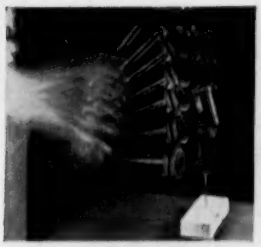
These savings continue in service, too, since replacement and repair of PYREX Pipe are practically nonexistent. Maintenance costs are incredibly low—one customer spends just $6.32 annually to maintain 1600 feet of PYREX Pipe carrying brine.

NEW BULLETIN. We've just prepared a new bulletin on PYREX Pipe which lists properties, design features, installation advice, sizes, fittings, and other useful information. Write for a copy.

CORNING GLASS WORKS, 111 Crystal Street, Corning, New York

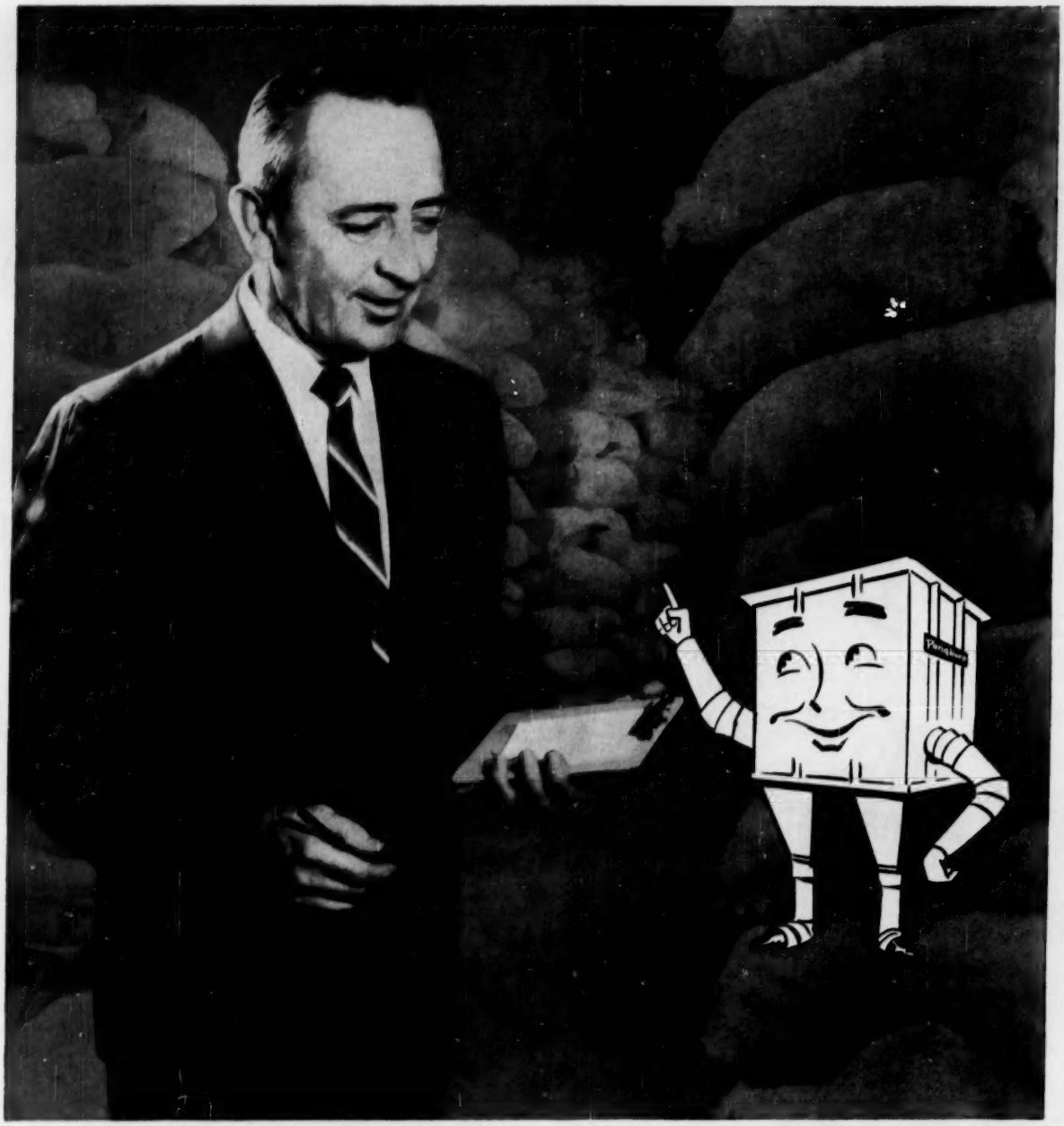
Corning means research in Glass





HAMMER-STRONG You can actually hammer nails through wood with "Double-Tough" PYREX Glass Pipe. A new heat-strengthened process gives additional strength at the joints where it is needed most.

EASY TO INSTALL Your own plant men can install this lightweight pipe. Connections are simple, require no hot lead, take just minutes. All standard fittings available. Pipe comes in lengths up to ten feet.



"You mean $15,000 a year salvaging dust?"

That's just what we mean! Many of our customers are clearing $15,000 a year and more from valuable material reclaimed by Pangborn Dust Control. Efficient Pangborn Dust Collectors trap dust at the source, gather it ready for resale, re-use or disposal. As a matter of fact, users of Pangborn Dust Control have made $20,000, $36,000, even $75,000 a year in salvaged dust, depending on the value of the dust collected.

What's more, Pangborn gives you other benefits of lower housekeeping costs, longer machinery life, higher employee efficiency and better employee and community relations. And Pangborn offers a complete line of collectors for all jobs.

Why not discover how you can profit from Pangborn Dust Control? Write for Bulletin 922 to PANGBORN CORP., 2600 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control & Blast Cleaning Equipment.*

SEE US AT THE CHEMICAL SHOW, DECEMBER 2-6, BOOTH 681

Pangborn CONTROLS DUST

Today at Westinghouse— men like these are engineering new dependability for process automation

Developments in motor design and insulation . . . static control systems and power rectifiers show how Westinghouse engineering and research provide new dependability for confident expansion of automatic operation. Engineering is constantly probing, exploring and identifying the practical. Thus improving present products with better protection and longer life. You profit from minimum process interruption, reduced maintenance costs and new opportunity to expand safely.

Motor problems in chemical and petroleum processing dictated the design and improved materials for the Life-Line® "A" totally enclosed motor. Since insulation is a major factor determining process motor life, Westinghouse introduced Bondite* stator insulation. Bondite is a silicone-reinforced thermosetting varnish that has outstanding resistance to *both* corrosive liquids and vapors. Some stator insulations can be dipped into water with no adverse effect, but have low resistance to vapor. Bondite seals out both, whether water, oil or chemical.

In addition, Westinghouse Bondar* conductor insulation has a life expectancy of more than three times that of conventional conductor insulations. It improves resistance to heat, provides greater dielectric strength and greater resistance to moisture, oils, dust and dirt.

(*Continued on next page*)

MP-3053-1 *Trade-Mark

YOU CAN BE SURE...IF IT'S Westinghouse

Here's proof of new dependability to advance automation

Cypak static control and power bus

Cypak outlasts conventional control 15 times. Cypak* is the first static industrial control system with no moving parts to wear, corrode or jam. It is a revolutionary means of providing automatic electrical control for processing operations and coordinated materials handling. The Cypak memory operation is also designed for complete plant alarm systems.

Westinghouse Silicon Rectifiers are static devices which have been developed for use in the 300-volt class and below. Air-cooled Silicon Rectifier assemblies withstand extremely high temperatures and have an efficiency equal to or better than other conversion equipment.

Thermalastic, the insulation with a memory, remembers to expand and contract with the coil. This prevents tape separation, the major cause of insulation failure. Thermalastic® Insulation ignores water, chemicals, dirt and other contaminants. Over 40-million hp are protected by Thermalastic Insulation throughout industry today.

Large motor drive demonstrates 30% better protection.

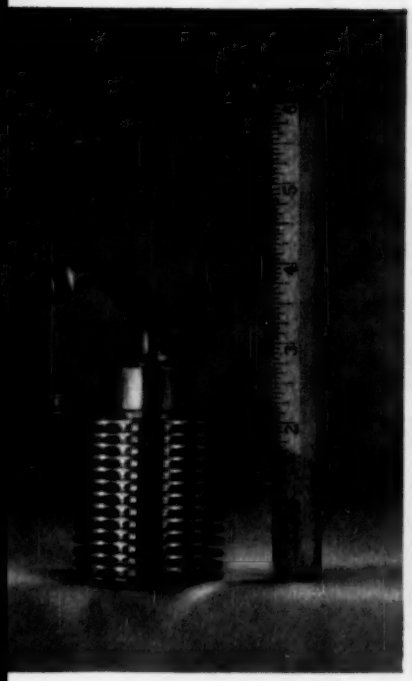
Thermalastic-insulated coils have proved a dielectric strength 30% higher than conventional types. In the picture at the right, water is sprayed into the air inlet opening while this 600-hp, 4160-volt squirrel-cage motor is running at normal speed. Immediately following the spraying, the coils successfully withstood three times the normal line-to-ground voltage.

Ten years ago, this picture could not have been taken. Thermalastic Insulation is the result of nine years' research and engineering and several million dollars' investment by Westinghouse.

Investigate all the many Westinghouse developments for drive dependability by calling your local Westinghouse salesman; or write, Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania. MP-3053-2

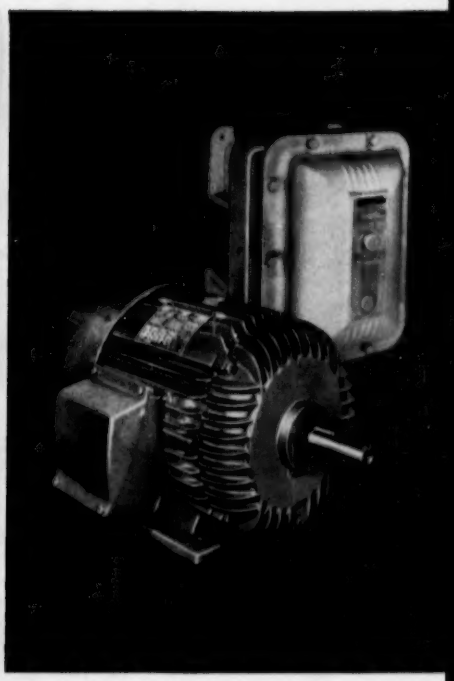
*Trade-Mark

YOU CAN BE SURE... IF IT'S Westinghouse



Westinghouse Silicon Rectifier

Applying Thermalastic Insulation



Life-Line "A" Motor and explosion-proof Life-Line Starter

MP-3053-3

Sulphur

helps to create headline products

ALUMINUM

Surely a 'headline product' even if not new! Aluminum is very much in the news today for it is playing a leading role in our steadily expanding economy.

What's all this got to do with Sulphur?

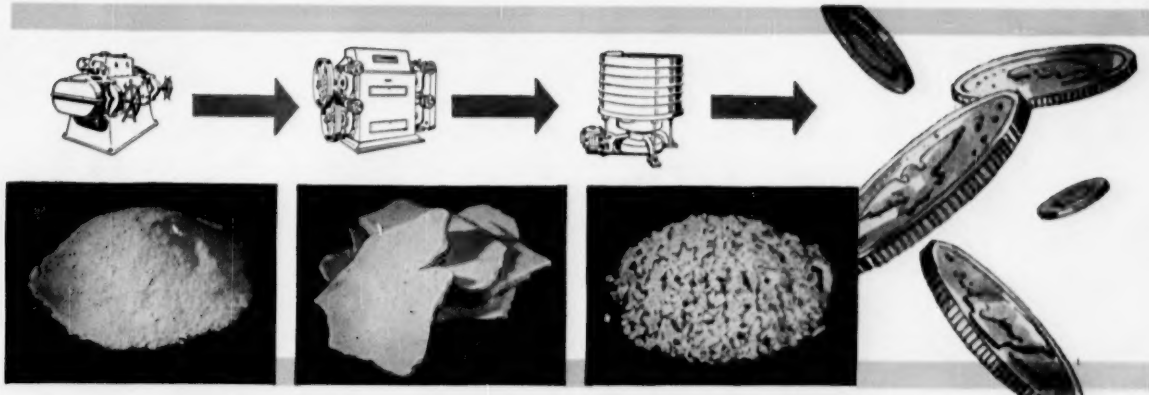
It's like a chain reaction. Demand for this remarkable light metal is increasing. This calls for more ore development and additional mills for the reduction of alumina to aluminum. More cryolite is needed for fluxing the molten alumina in the electrolytic cells.

True, cryolite (Na_3AlF_6) is found in nature but there just isn't enough tonnage to satisfy its many uses. So, to fill the supply gap, cryolite is being synthesized from fluorspar. It is here that Sulphur enters the picture, for one of its widely used derivatives – Sulphuric Acid – is a key reaction agent.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas

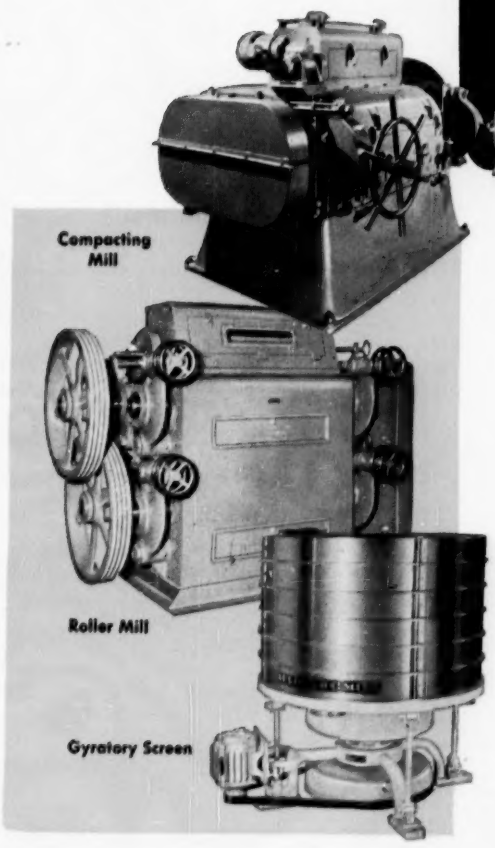
Sulphur Producing Units
- Newgulf, Texas
- Moss Bluff, Texas
- Spindletop, Texas
- Worland, Wyoming



Converts WASTE into PROFIT

ALLIS-CHALMERS Compacting Process

it's mechanical
it's economical



You start with a pile of practically worthless material and wind up with a profit! Magic? Well, hardly – unless you want to call the mechanical efficiency of the Allis-Chalmers Process System magic.

How It Works

In a recent installation the conversion starts with an unusable, unacceptable minus 30 mesh chemical salt . . . fines created in the original process. An Allis-Chalmers compacting mill densifies these fines into flakes or slabs. Flakes are granulated in an Allis-Chalmers roller mill. Final separation is made in an Allis-Chalmers stainless steel gyratory screen. Result – 70 to 80% recovery of salable product. What's more – the resulting granules equal or surpass the natural product in every respect.

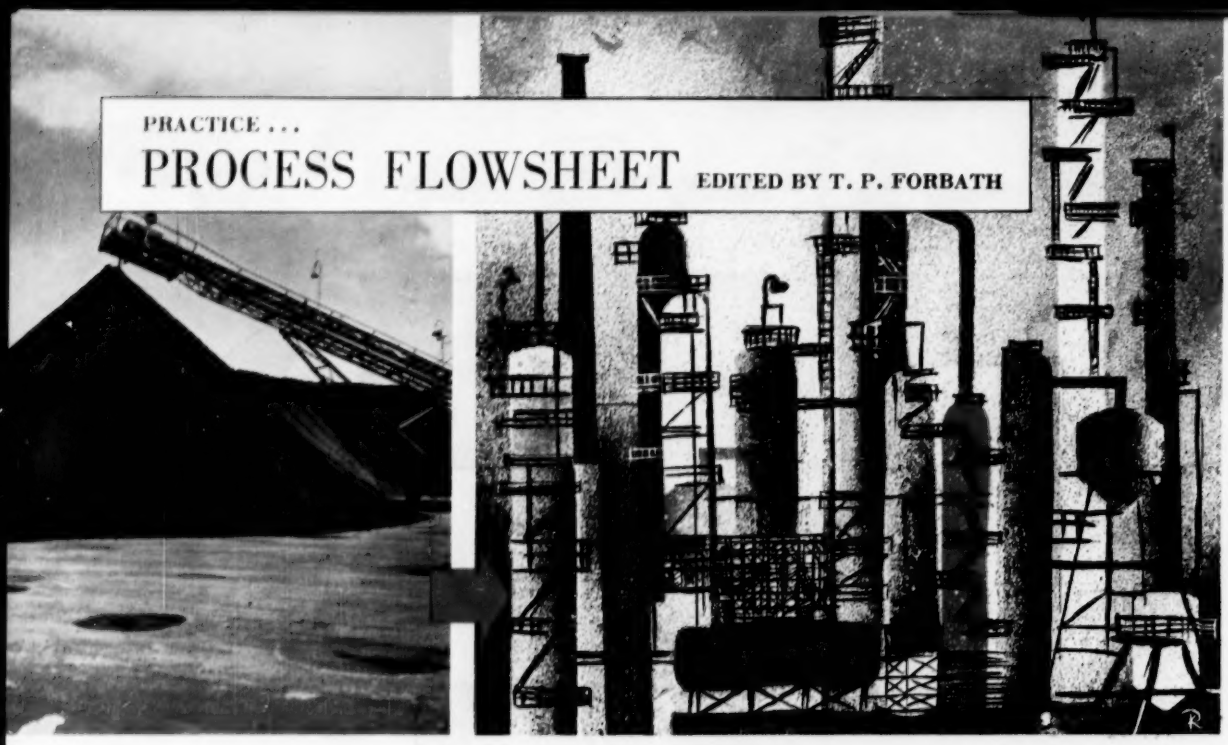
The entire system is mechanical; therefore, it's more economical than controlled crystal growth.

For More Information

Get the complete story from your A-C representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. Ask for Bulletin 25C6177J.

ALLIS-CHALMERS

A-5345



PRACTICE . . .

PROCESS FLOWSHEET EDITED BY T. P. FORBATH

Solid Gilsonite Feeds "Petroleum Refinery"

- **High-octane gasoline produced competes on Utah-Colorado market.**
- **Electrode-grade coke goes to Pacific Northwest's aluminum industry.**

In western Colorado, near Grand Junction, in a landscape that stands among the U.S.'s most wildly dramatic, American Gilsonite Co. swung on stream what, to all intents and purposes, is a highly engineered, neatly integrated petroleum refinery for the manufacture of high-octane gasoline and electrode-grade coke.

That is, it's a petroleum refinery in the conventional sense in all but one overwhelmingly novel detail. The new plant charges, not a petroleum crude feedstock, but a solid, asphalt-like hydrocarbon mineral called gilsonite.

Completing shakedown in August, the $18-million installation at Fruita, Colo. now turns out 55,000 gal./day (1,300 bbl.) of gasoline and 275 tons/day of coke from 650 tons gilsonite. But design and engineering of the plant—the work of a team that included Foster Wheeler, H. K. Ferguson, Petrocarb Equipment, Kaiser Engineering, Standard Oil of Calif. and AGC itself—allows plenty of room for expansion. For example, the facility presently takes up only 50 of the 1,200-AGC-owned acres available. First expected expansion will push gilsonite throughput to 1,100 tons/day and boost coke output to 550 tons, gasoline to over 100,000 gal.

▶ **First in Race**—This unusual refinery makes its commercial debut at a time when petroleum and chemical processors are buzzing pretty interestedly over a variety of projects for producing conventional petroleum products from raw materials other than crude oil. For example, there's Amoco Chemicals' Fischer-Tropsch oil-from-gas process at Brownsville, Tex. and Union Oil of Calif.'s oil-shale scheme near Grand Valley, Colo.

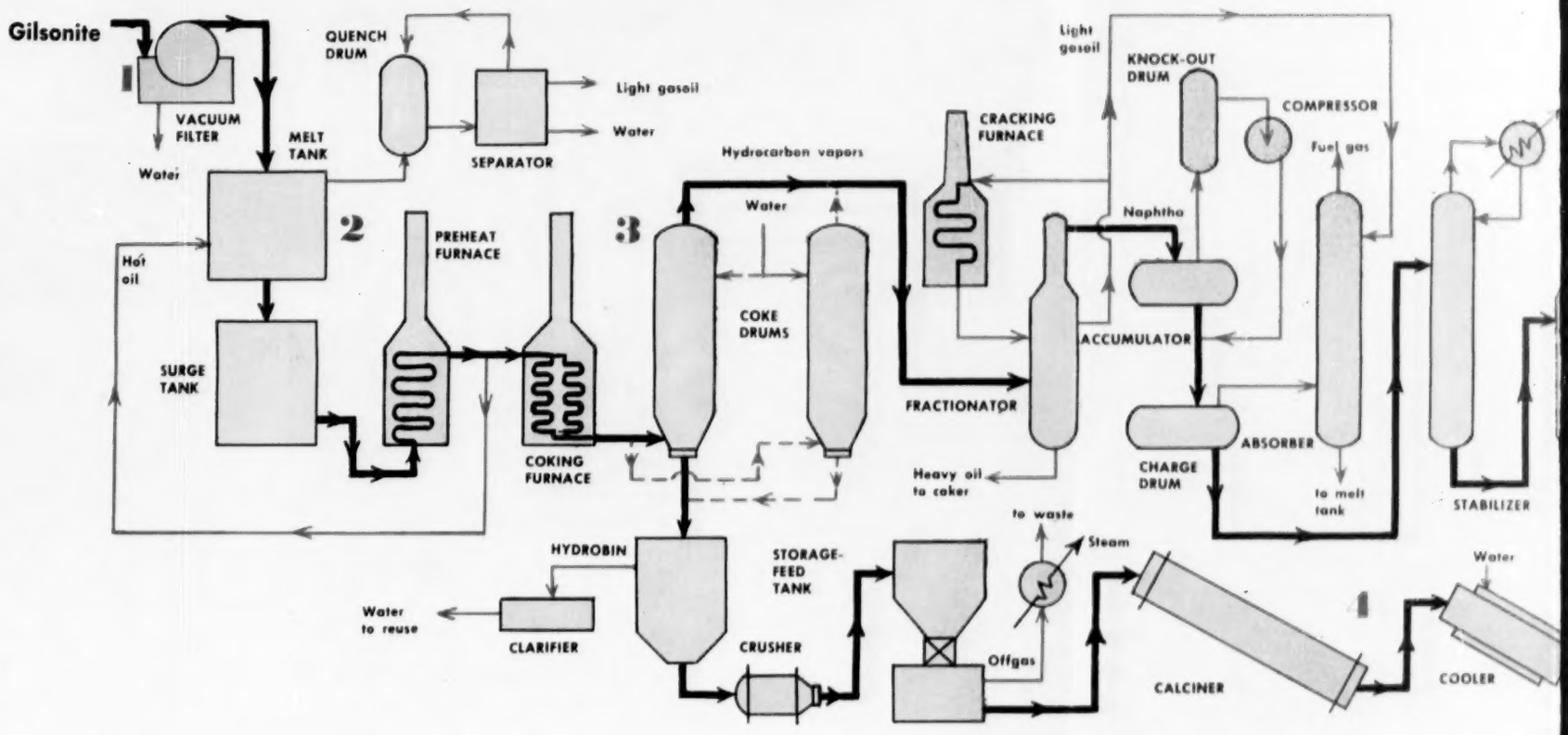
AGC can now stake its claim to being the first privately financed commercial outfit to accomplish this problem-plagued processing feat. And it was done entirely economically. Both products market at prices that compete with their crude-oil-derived cousins —12¢/gal. for gasoline, $30/ton for coke.

▶ **Original Plans Stick**—From drawing board to on stream, a trip that included over a decade and $1 million of research, and a 100-ton/day pilot plant put through pretty vigorous paces, AGC stayed faithfully with its original process plans. And the plant on stream today is a remarkably close likeness of the one that AGC President E. F. Goodner outlined over a year ago (see *Chem. Eng.*, Sept. 1956, pp. 134-136) when AGC first broke ground.

▶ **Special Conditions**—Still, gilsonite posed some special processing conditions not faced with conventional petroleum refinery charge stocks. And to handle them AGC engineered a number of pioneering techniques that only now, with the plant actually in operation, have proved out.

• A 72-mile, 6-in. pipeline carries about 700 tons/day of gilsonite, slurried in water, from AGC's Bonanza, Utah mine to the Fruita refinery (see *Chem. Eng.*, Oct. 1957, pp. 249-254). This striking piece of engineering hands AGC a handsome economic advantage for it provides a refinery feed costing under $2/bbl. Petroleum crudes in the area top $3/bbl.

• A thermal reforming plant makes hydrogen



from a captive butane-propane stream to supply the catalytic hydrogenation and reforming stages. For unlike most catalytic reforming operations, AGC's results in a hydrogen deficiency rather than a hydrogen make. Reason: High olefin and nitrogen contents of gilsonite coker gasoline voraciously consume hydrogen for bond saturating and formation of ammonia.

▶**Gilsochemicals Coming?**—Unique nature of gilsonite, besides raising special process considerations, offers what may be the mineral's—and the refinery's—most exciting potential. Gilsonite, Goodner feels, could become the basic raw material for a large family of chemicals.

AGC is investigating some of these "gilsochemicals", Goodner's semantic takeoff on petrochemicals, and currently has applied for patents covering their manufacture. While AGC isn't ready to elaborate on this point, at least one "gilsochemical" will probably be produced at Fruita in the near future. That's ammonia. Right now hydrogenation stage turns up 3 tons/day that goes to waste. But refinery expansion could push NH_3 output to the point where its recovery becomes economically worthwhile.

▶**How Refinery Works**—Gilsonite-water slurry from pipeline is first dewatered in a 18-ft.-long by 9-ft.-dia. rotating vacuum disc filter. From this point, damp gilsonite, containing roughly 20% water, travels on a belt conveyor to 17-ft.-high by 30-ft.-dia. melt tank. A side stream is tapped to build and hold a gilsonite reserve storage pile of 20,000 tons.

Dual star-wheel feeders send gilsonite into melt tank and jets of hot oil melt it. This heating oil comes from all refinery oil streams except the raw naphtha. Molten stream in tank, at about 450 F. (gilsonite m.p.: 350 F.), consists roughly of two parts recycle and one part gilsonite.

Steam and light oil vapors are driven off in the melt tank and are condensed, separated, recovered and reintroduced to the system. Molten stream feeds through a preheat furnace where it's brought to 610 F. Part of this stream recycles to the melt tank. Remainder, roughly 11,600 bbl./day, goes to the delayed coking stage.

▶**Coking and Calcining**—Feed passes through a direct-fired horizontal updraft heater, operating at 910 F., where it's cracked into a wide range of molecules from hydrogen through naphtha, gas oils, heavy oils and carbon. Mixed stream then enters one of two 82-ft.-high by 18-ft.-dia. parallel-hooked coking drums. There liquid separates from vapor, and coke precipitates from liquid to deposit on walls. When drum is filled sufficiently, cracking furnace discharge switches to second drum. A high-pressure jetting device, held by 200-ft.-tall derrick over coking drum, delivers a 2,200 psi. water stream into the drum and cuts coke from the walls.

Some 340 tons/day green coke in 2.5 million gal./day water discharges from coke drum to be calcined. Large coke lumps are broken in a crusher and water is decanted. Then green coke goes through a 180-ft.-long by 10-ft.-dia. sloping, rotating (1 rpm.) kiln. Operating at 2,300 F., this calciner drives off water, volatile and combustible materials to produce "cured" coke. It's cooled in a water-jacketed, rotating (3 rpm.) drum, 80 ft. long by 8 ft. dia. Railroad cars carry product to aluminum and stainless steel marketplaces.

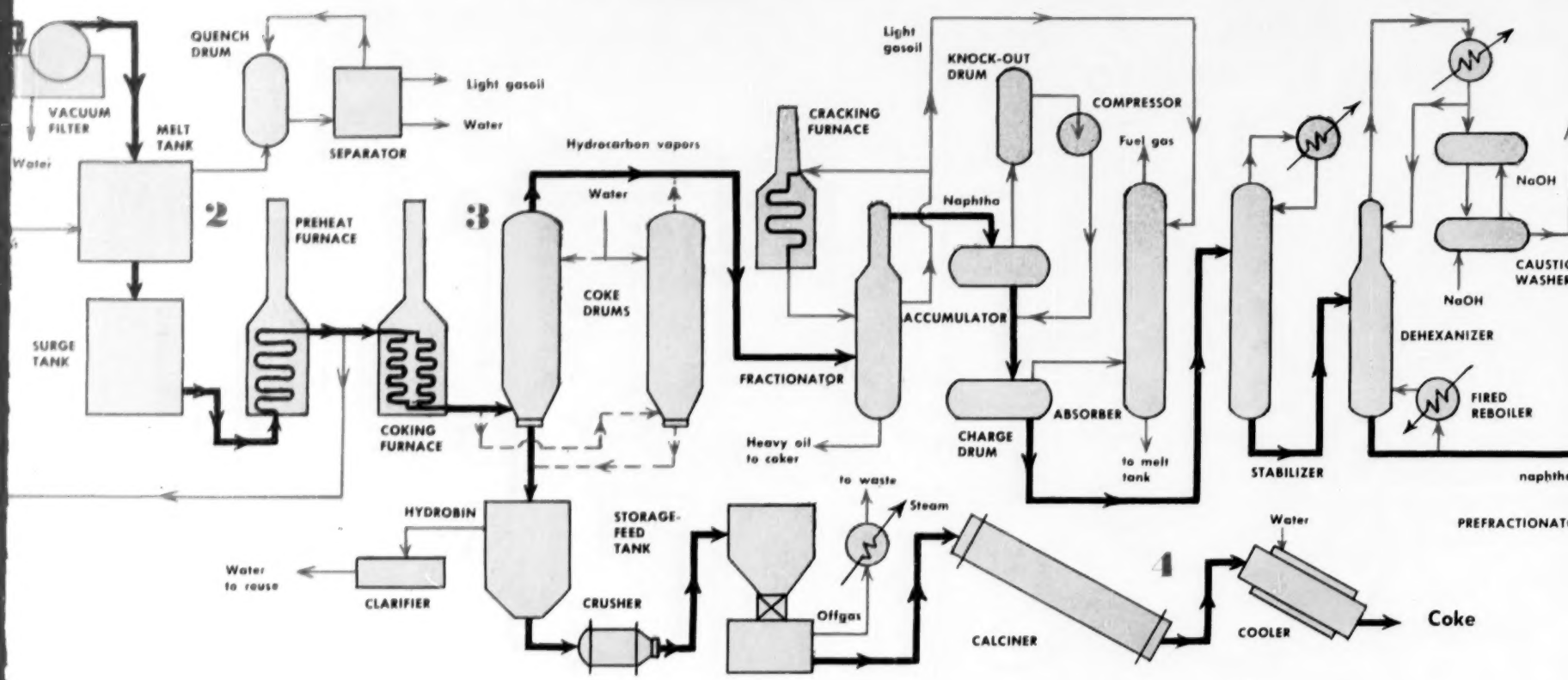
▶**On to Gasoline**—Effluent gas stream from coke drums, at 810 F. and 30 psi., enters a 95-ft.-tall by 11-ft.-dia. fractionating column that cracks out a raw naphtha overhead (b. p.: 300 F.), a light oil heart cut (500 F.) and heavy gas oil bottoms (580 F.). Bottoms stream recycles to melt tank. Light gas oil is thermally cracked at 985 F. in a furnace and recycled to the fractionating column to produce more naphtha.

Raw naphtha overhead is cooled, condensed and stabilized, then feeds to a two-stage reforming operation—Union Oil of Calif.'s Unifining followed by Union Oil Products' Platforming.

First, stream is dehexanized and overhead fraction, after being caustic washed, goes to storage for blending with final gasoline product. Bottom cut (320 F.) goes to a 110-ft.-high by 4-ft.-dia. prefactionator where a 450-F. bottom stream is cracked out to recycle to coking oven. The 300-F. heart cut from this column then joins hydrogen to feed through three, series-hooked hydrogenation reactors, filled with a fixed cobalt-molybdate catalyst bed. Hydrogen for this operation is supplied by a thermal reforming plant that feeds on LPG turned up at a later point.

Hydrogenated stream is desulfurized, then feeds through three series-hooked fixed-platinum-bed filled catalyst cases alternating with three heaters. Reformate produced is stabilized in a column the overhead of which provides LPG for the hydrogen-making plant.

Stabilized gasoline is blended with tetraethyl lead and hexane, and the product goes to the gas stations of the Colorado-Utah area.



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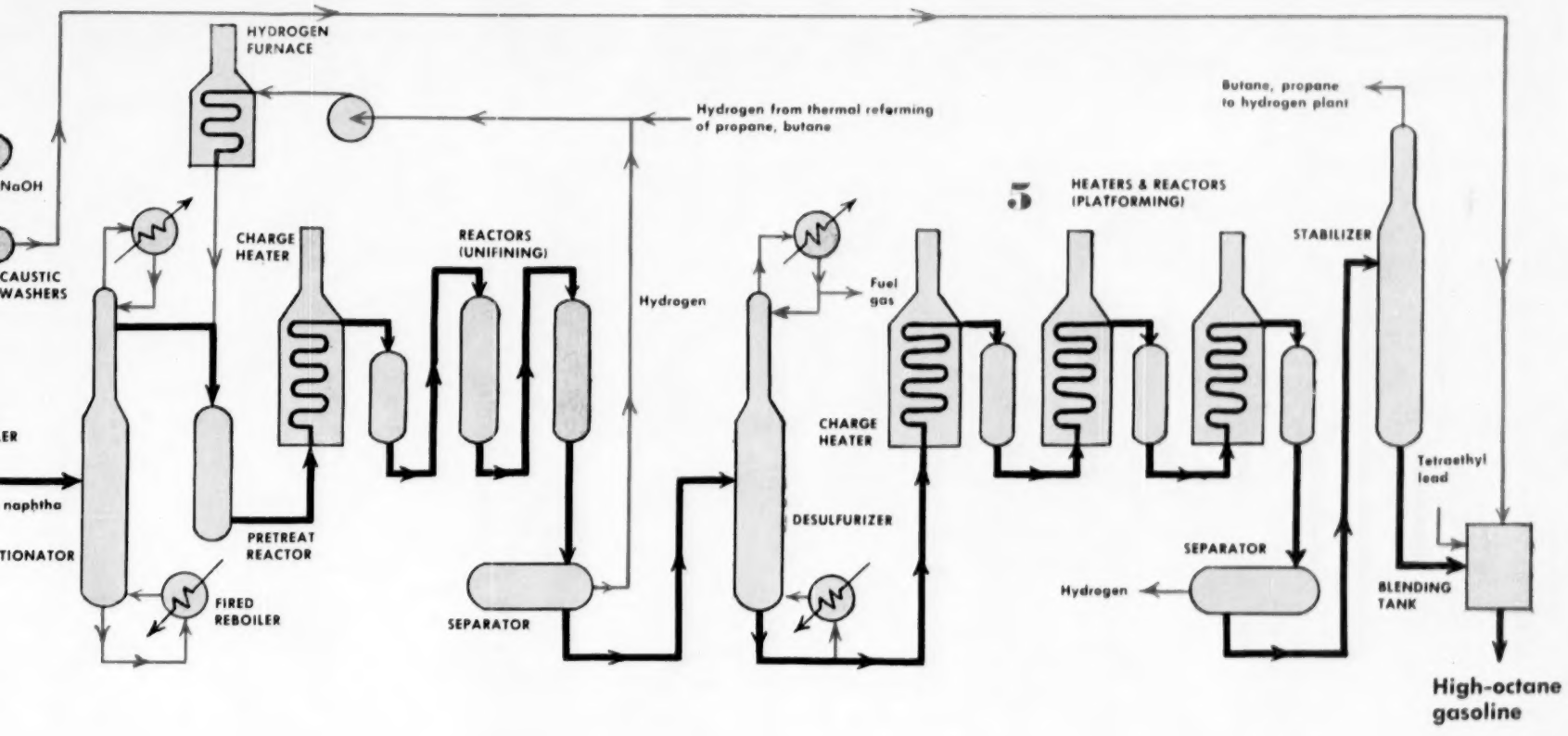
1 VACUUM FILTE
sonite slurry carri

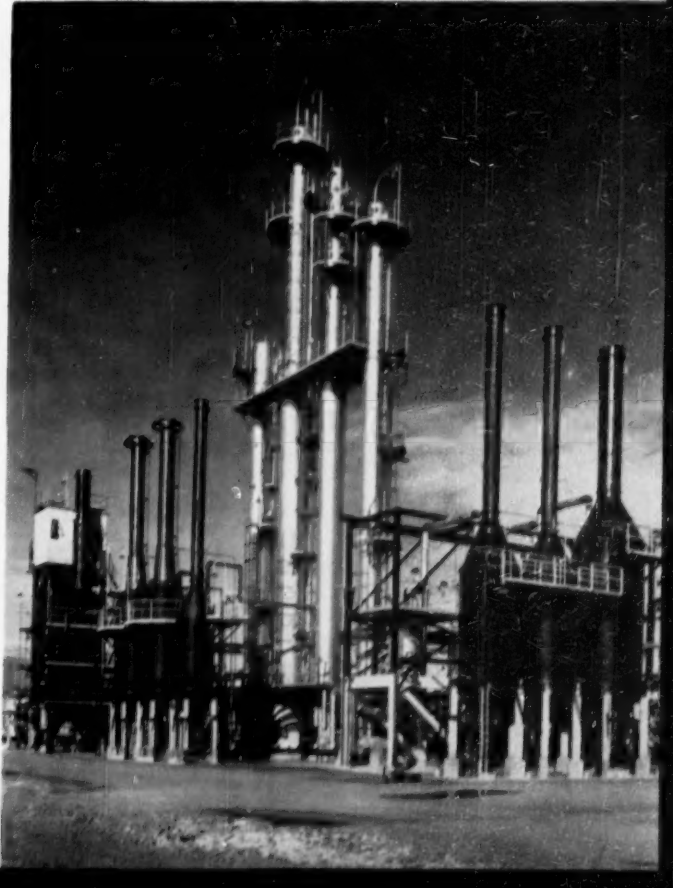
3 DELAYED COKE
into green coke a



FILTER separates water from gil-y carried to plant by 72-mile pipe.

2 MELT TANK receives dewatered gilsonite. Hot recycle-oil streams melt gilsonite; steam and vapors are separated in tank at left.

5 CATALYTIC REFORMING of raw gasoline (Unifining, Platforming) produces high-octane product.

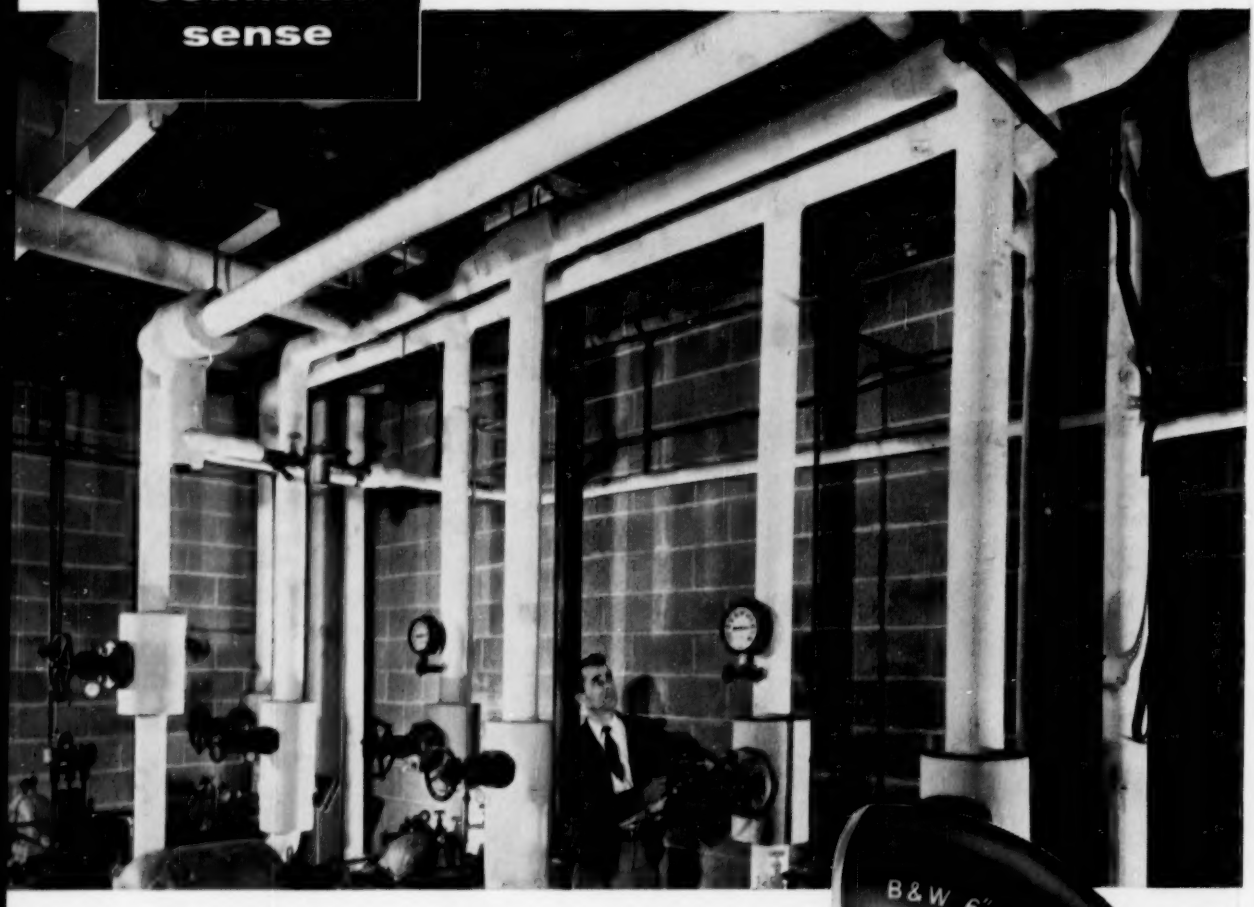


COKER cracks liquid gilsonite coke and hydrocarbon vapors.

4 CALCINER drives off water, volatile and combustible materials from green coke; after cooling electrode-grade coke is ready for marketing.

result of an engineer's good common sense

This piping installation is here to stay, thanks to B&W Seamless Welding Fittings



THE engineer who specified B&W Seamless Welding Fittings on this boiler job knew what he was doing. He realized the system would have to be permanent and leakproof for many years to come. He also realized how much time and money could be saved in fabrication, and, of course, insulation. Therefore, it was only natural that he chose welded connections since they actually become part of the piping system and are as strong, or stronger than the pipe itself. Pipes nest closer and the overall system is considerably lighter.

B&W Seamless Welding Fittings are dimensionally accurate. Full radius, true circularity and smooth walls of uniform thickness provide a smooth, fast-moving flow even under highest temperatures and pressures.

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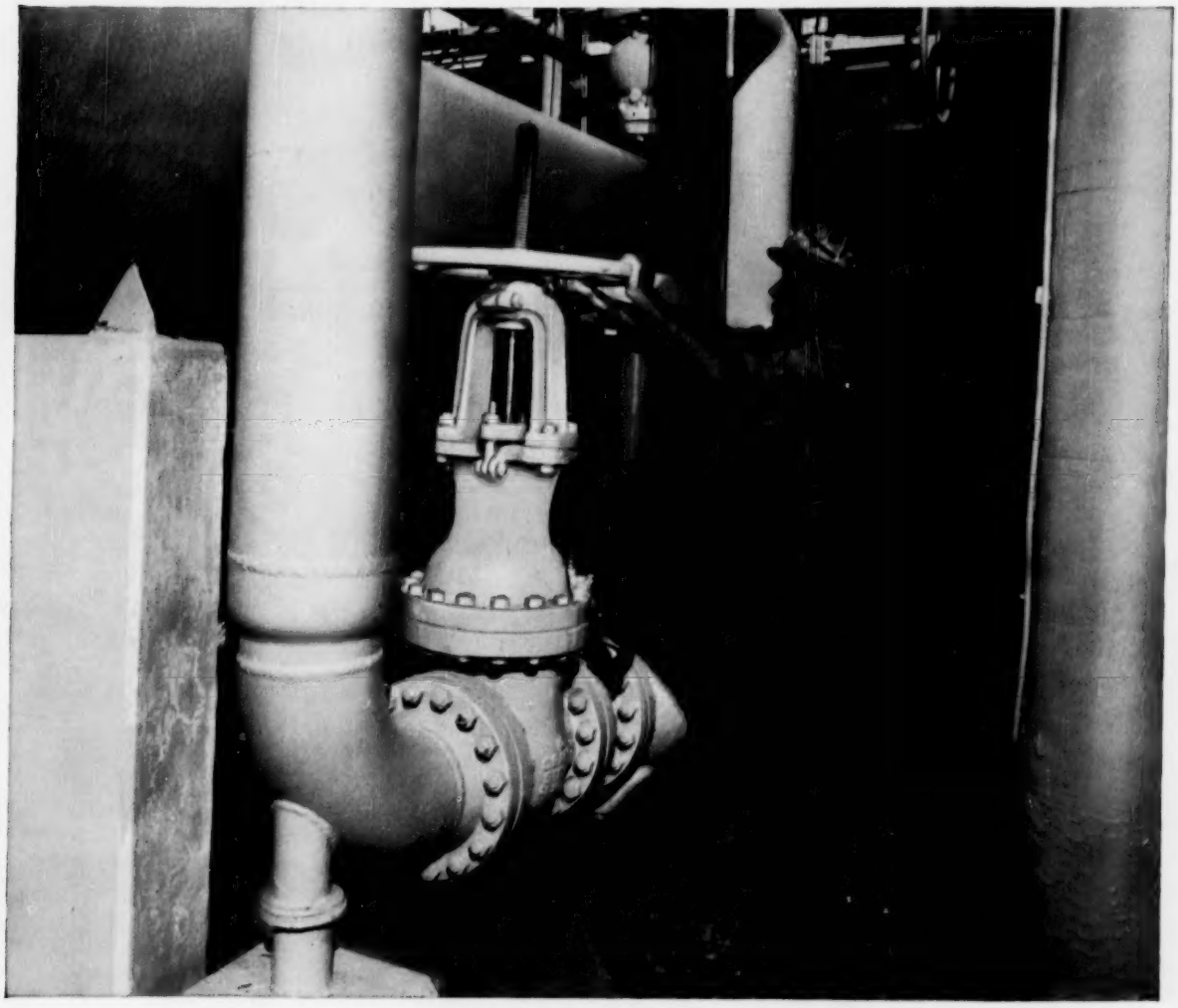

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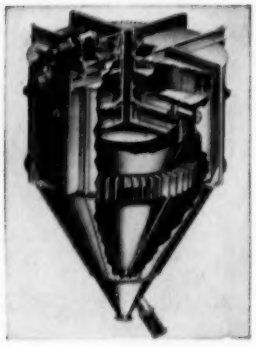

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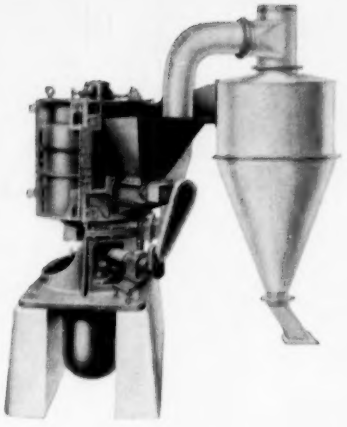
You are cordially invited to visit our Booth #646 to obtain information and descriptive bulletins of Raymond equipment in which you are interested.



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RAYMOND
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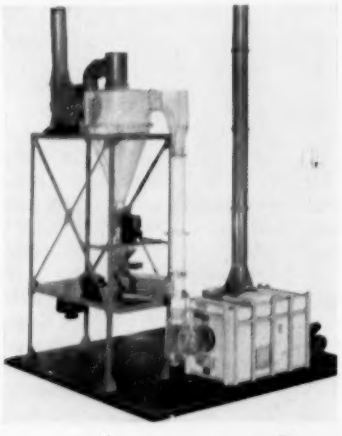

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Chemical Engineering

Practice

This refinery feeds on solid gilsonite .... TURN BACK TO **222**

Against a dramatic Colorado backdrop, one of the most highly engineered gas-coke units has swung on stream.

When you're evaluating a project **231**

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Take a look at this new operational and cost information on solvent extraction of uranium.

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Add this selection of references on design and cost to your file. It'll help you solve separation snags.

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No longer a temporary stand-in for metals and alloys, now consider plastics as a material of construction.

NOVEMBER 1957

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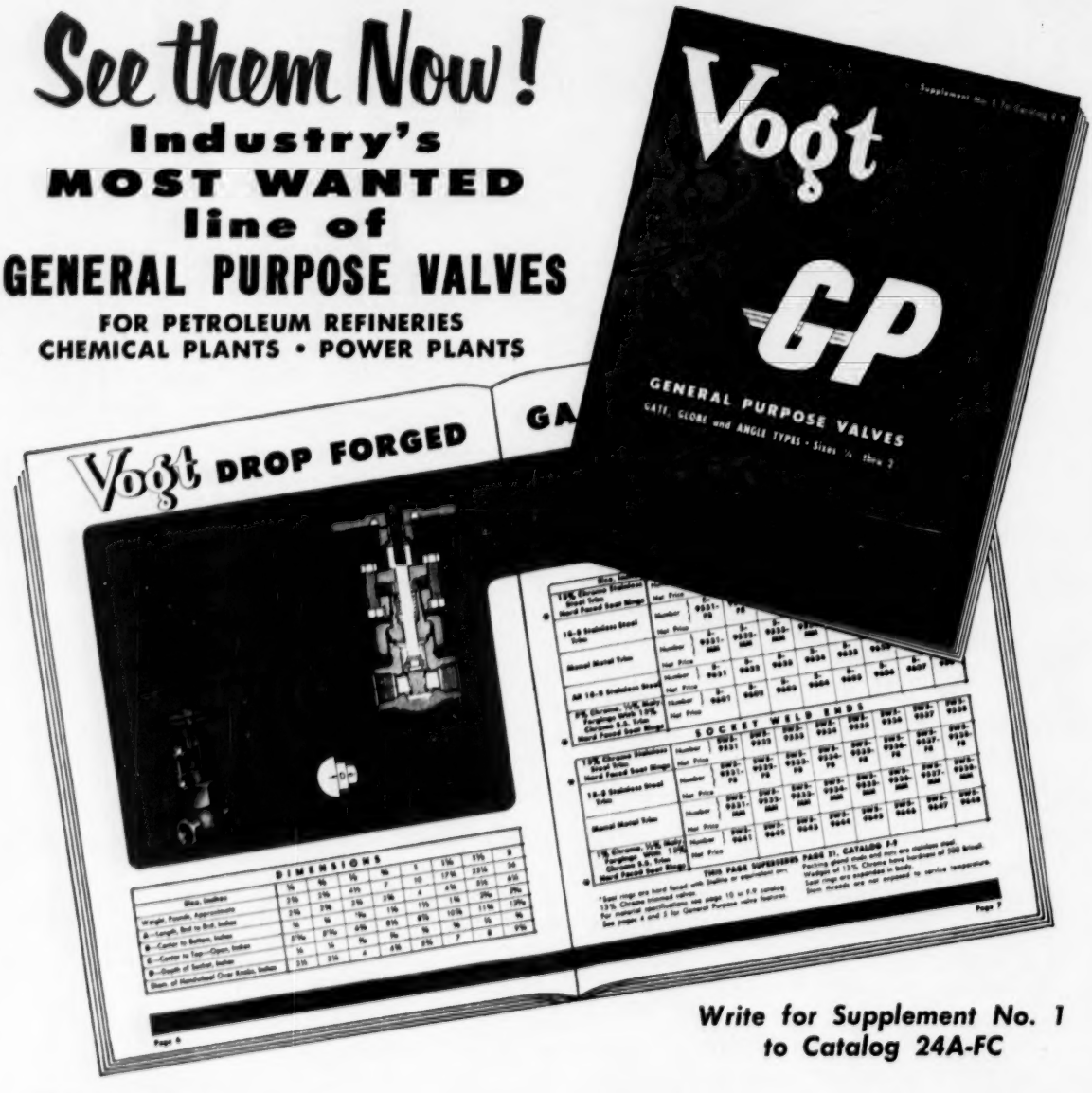

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VALVES

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Chemical Engineering
NOVEMBER 1957

Re-evaluate Your Capital Investments

Are you missing the not-so-obvious costs in project evaluations? Here's a new way to look at your capital investments in terms of the cash requirement and the gross investment.

MORRIS SANDEL, JR., Reynolds Metals Co., Richmond, Va.*

It has truly been said that our American enterprise system was founded and continues to thrive on its methods of mass production and the expansion, modernization and replacement of the producing facilities. Since the early days when our present concepts of mass production were born, there has been an ever-increasing demand for investment in capital equipment.

Today, industry is making plans for enormous capital outlays. Are these funds being invested where they will yield the greatest return and thus insure continued growth of our economy? Possibly not.

A surprisingly large number of companies still calculate their investments for a project as the money necessary for just the buildings and equipment. Of course these costs are important, but there are additional not-so-obvious costs that should be included.

For instance, many boards of directors have been lulled into investing in a project that looks good on the surface and has an acceptable return on the investment in new buildings and equipment. But because the project uses a large part of existing company assets such as roads and sewers, it would have an unacceptable return on gross investment.

In such a case, it would be wiser for the board of directors to invest in another project or diversify into another line. Under no circumstances should an investment downgrade a company's operation by burdening it for years to come with a project that does not pay its own way for the use of existing company assets.

Therefore, each project should have a return calculated on the cash requirement and the gross investment. Then the board of directors is in a position to measure both against a standard minimum.

It's a well known fact that selecting the projects with the highest return on the cash requirement will insure compounding capital money at the highest possible growth rate. This money may come from depreciation, new financing or retained earnings.

However, the cash going into a project will seldom be as large as the total company assets involved as described above. Now here lies the advantage of selecting those projects that show the highest return on incremental cash requirement and gross investment. Your company can then be certain of compounding the larger amount of assets at the highest rate.

For the purpose of clarity, these two terms will be defined. Incremental cash requirement is the amount of cash on the line needed for a project. It includes direct investment, operating expenses, tax credits and working capital. Gross investment is the total of all company resources that go into a project. Included are all the items above plus the dollar value of credit for excess new utility capacity, transferred existing facilities and allocated existing facilities.

As you'll see, it's possible to estimate the elements going into these two yardsticks. There's no single magic formula that makes the estimating easy and foolproof, but by making a few simplifications and assumptions, the task can be well worth the effort.

Don't Forget Revisions

Expenses for revisions are those expenditures for repairs to existing equipment that will be involved in the project, installation of temporary facilities to avoid interruption of production during construction, tearing down equipment and buildings and relocating equipment. Cost of these operations would normally be calculated as part of the engineer's estimate to construct the project.

These expenses offset an equal amount of profits and carry a credit at the current tax rate, which for simplicity we'll calculate at 50%.

For example, assume we plan to build an $80 million expansion to an existing plant to reduce 400 million lb. of alumina to 200 million lb. of aluminum by means of an electrolytic process.

Because the new and existing plants will share general electrical and sewer facilities, it will be necessary to construct temporary connections while making the permanent tie-ins so as not to interrupt production. These connections, costing $1 million in ma-

* Meet your author on page 324.

How to Estimate the Cost of Allocated Facilities

Adjust Direct Investment of Expansion

Direct investment, expan.		$80,000,000
General facilities, expan.	−5,000,000	
Excess utility capacity, expan.	−30,000	
Allocated utilities, expan.	+75,000	
		−4,955,000
Adjusted direct investment, expan.		$75,045,000

Determine Fraction of Original Plant Cost That is General Facilities

Direct investment, orig.		$110,000,000
General facilities, orig.		−10,000,000
Adjusted direct investment, orig.		$100,000,000

$$\left(\frac{\text{General facilities, orig.}}{\text{Adjusted direct investment, orig.}}\right) = \left(\frac{10{,}000{,}000}{100{,}000{,}000}\right) = 0.10$$

Find Gross Allocated General Facilities of Expansion

$$\left(\frac{\text{General facilities, orig.}}{\text{Adjusted direct investment, orig.}}\right)\left(\text{adjusted direct investment, expan.}\right) =$$

Gross allocated general facilities = (0.10) ($75,045,000)
= $7,504,500

Next, Find Net Allocated General Facilities of Expansion

Gross allocated general facilities, expan.	$7,504,500
General facilities, expan.	−5,000,000
Net allocated general facilities	$2,504,500

Result is the Total Allocated Facilities of Expansion

Net allocated general facilities	$2,504,500
Allocated utilities, expan.	+75,000
Total allocated facilities	$2,579,500

Not-So-Obvious Costs Can Throw Your Estimate 10-20% Off

Direct investment		$80,000,000	
Operating expenses	1,000,000		Bare cost of buildings and equipment.
Tax credit	−500,000		
Working capital	3,827,500		
		4,327,500	You actually need over $4 million cash more than direct investment.
Incremental cash requirement		84,327,500	
Excess utility capacity	−50,000		
Transferred facilities	2,000,000		
Allocated facilities	2,579,000		
		4,629,500	Gross is 11% more than estimated direct investment
Gross investment		$88,877,000	

terial and labor, will be removed and retired when the permanent tie-ins are complete. Operating expenses will thus be $1 million and the tax credit will be $500,000.

Some companies may not be in the habit of including the expense for revisions and the tax credit in the cost of a project. One project may require a large expenditure to relocate existing equipment or other large expenditures classified as an operating expense, and another may not. If the evaluation does not include the cost of these related expenses and the 50% tax in the first case, then it has an unwarrented advantage in the comparison.

Working Capital is Necessary

Working capital is defined as the excess of current assets over current liabilities. It is the amount of money a new company would be required to have in the bank to put an operation on a running basis after all construction were complete. It would cover the excess of such current assets as inventories, accounts receivable and cash over such current liabilities as taxes, accrued wages and notes and accounts receivable.

Inventories—Included in this category are raw materials, goods in process, fuel, container and supplies inventories. If a thorough economic study of the project has been made, the working capital tied up in these items can be calculated from their annual cost. A good rule of thumb is to maintain a minimum of one month's supply on hand. Special conditions such as distance and reliability of the supplier may cause this to be a shorter or longer time.

For example, assume in our previous example the alumina had to be shipped from the Gulf Coast, up the Mississippi and then up the Tennessee River. Normally, the barge trip upstream takes two weeks. During high water the trip takes three weeks and in times of extreme floods it might be impossible.

A complete tow would run the plant about two weeks. Under ideal conditions no inventory would be required. A tow could therefore leave the Gulf Coast every two weeks and just as one tow was used up another would arrive. Few plant managers would be willing to guarantee production under these assumed ideal conditions. Because of possible floods, strikes, and breakdowns at least a one-month inventory would be carried. Thus, at $0.03/lb., the working capital required for alumina alone would be:
400,000,000/12 × $0.03 = $1,000,000

Accounts Receivable—This item is a function of net sales. Working

capital required to cover it depends on the total dollars of net sales and the average time lag to collect for sales made. Time lag is dependent on the type of discount given for prompt payments and is the incentive for giving discounts. Usually, accounts receivable carried on the books will average between one and two months.

Taxes—Items included under taxes are many and varied. State and federal income taxes are usually paid on a sliding scale installment basis. Payments of a small percentage on the total tax due are made in September and December and the bulk in March and June.

The ultimate goal of the collector is to have the corporations pay half of their income taxes within the same year that the income was earned. This will give the company the use of an average of ½ of the total annual tax bill for the entire year.

State income taxes vary by state. Generally these taxes are paid the year after the income was earned and would give the company the use of the money for an average of a full year.

Wages—This item may be disregarded in calculating working capital because wages are paid on a current basis.

Notes Payable—Money set aside to pay notes is a function of the type of financing. With the trend toward debt financing as it is, this can be a significant item. Obviously there is no set formula. However, the amount of money available for the company's use can be calculated easily when the amount and periods of payment are known.

Accounts Payable—Accounts on the books to pay for such items as raw materials and supplies are included in this item. It may be estimated by assuming that the company will have the use of money for these items for one or two months, depending upon the type of discount supplying companies give.

With Calculations . . . a Short Cut

It would be very laborious to calculate each of the items above for every economic evaluation. Many short cuts can be worked up which will facilitate these calculations. For a given process, a factor can be calculated that when multiplied by a few of the elements will give the correct answer.

For example, one short cut states: total working capital equals one-half of the total of all inventories plus accounts receivable. Remaining assets and all the liabilities are taken into consideration by this factor.

In our example, assume the following conditions:

Inventory	
Raw materials	
Alumina	$1,000,000
Other	50,000
In process, finished goods	250,000
Fuel	5,000
Containers	0
Supplies	100,000
Accounts receivable	6,250,000
Total	$7,655,000

Therefore, working capital = ½ × $7,655,000 = $3,827,500.

Some companies may not consider working capital as a necessary investment. This practice can lead to trouble. For instance, one project may require just about the same direct investment as another but may require much larger inventories or accounts receivable.

Any new working capital dollars are invested dollars as surely as new dollars invested in machinery or equipment.

Now for Excess Utility Capacity

As a demonstration of excess utility capacity let's consider the case where a project may require a small amount of air and none is available. Prospects of a future development may require that a large compressor be installed. Following our idea of allocating costs, the gross investment of the project should not be charged with the total compressor cost. Rather the cost that should be charged is that amount required to supply a compressor having no excess capacity, only enough for 100% operation of the project.

Thus a credit for excess capacity should appear. This excess capacity and the credit for it are simply determined by subtracting the amount the project will be charged from the total investment for the larger equipment.

For example: if a project required 1,000 std. cfm. and a compressor delivering 2,000 std. cfm. and costing $100,000 was installed, the excess capacity would be 1,000 std. cfm. Credited would be the difference between the $100,000 invested and the cost of a compressor that would be required to deliver the necessary 1,000 std. cfm. ($70.-

Select the Project That Yields the Highest Return on Gross Investment

Here is the fooler in cost estimates

	Capacity, Millions of Lb./Yr.	Gross Investment, Millions of $	Incremental Cash Requirement, Millions of $	Net Profit, Millions of $	Net Return on Gross Investment, %	Net Return on Incremental Cash Requirement, %
Expand existing site	200	89	84	10	11	12
Develop new site	200	90	90	10	11	11
Small expansion, existing site	110	50	41	5	10	12

000). This would be $100,000 — $70,000 = $30,000.

What Are Allocated Facilities?

Allocated facilities are those existing plant utilities, buildings, shops, railroads, sewers, etc., that will be used in conjunction with running a project in an existing plant site. To be included in the gross investment is the present-day replacement value of a fair share of the facilities used.

For calculating purposes, allocated facilities are divided into two groups: utilities and general facilities.

For utilities, the amount to be included is the replacement cost per unit of capacity, multiplied by the number of units of capacity the project will use. If old investment costs are available, they should be scaled up in accordance with an acceptable cost index.

For example, if the original cost of a 100,000 lb./hr. boiler was $500,000 when the index was 400 and the present index is 600, then the present-day replacement cost is $750,000 or $7,500 per 1,000 lb./hr. capacity. If the project under consideration uses 10,000 lb./hr., the amount to be included under the gross investment is $75,000.

Once the cost per unit of capacity is thus calculated for a given location, it can be used repeatedly for different studies.

For allocated general facilities, the amount to be included is found as follows: (1) Correct the direct investment for the project by subtracting any excess utility capacity and general facilities and adding in any allocated utilities. (2) Multiply the adjusted direct investment by the fraction of the original plant cost that is general facilities (cost of the original general facilities divided by the original adjusted direct investment). This gives the gross allocated facilities. (3) Subtract the general facilities included in the project estimate. This is then the net allocated general facilities. (4) Total allocated general facilities is the net allocated general facilities plus the allocated utilities for the project.

If Facilities Are Transferred

All facilities transferred to the project from within the company are handled alike. Transferred value can be taken as the present day replacement cost but more often they are taken as the depreciated value (net book value). This is done to offset higher repair costs. Assume in our example that we transfer $2 million of electrical equipment from an existing plant.

Is Gross Investment Useful?

From the figures of our typical plant expansion we can see that because of not-so-obvious costs the incremental cash requirement is more than $4 million above the bare costs of buildings and equipment. At the same time, the gross investment is almost $9 million higher. These are the bare costs that so many companies still continue to consider the total investment required for a project.

We've seen from this typical example how this concept of allocating not-so-obvious company assets to a project changes the investment required but how can it be made useful?

Consider that you are on the board of directors of a very large diversified company (it works equally well for small companies). You have a report from the market research group that states your company should install capacity to produce 200,000,000 lb. of aluminum pig per year. All of the possible expansion sites have been studied by the planning group who in turn have boiled them down to two possibilities and submitted them for your decision.

One is our previous example of adding the capacity at an existing site, the other requires the opening up of a completely new site. These possibilities are compared in the table on page 233. Here we see that the case with the higher return on incremental cash requirement is the preferable project. However, in this case, the return on gross investment is not too significant because the same conclusion could be reached without it.

But let's look at another comparison submitted to you as a director for your decision; the new project being compared in the previous table is a smaller expansion at the same site.

In this simplified comparison we see how the return on gross investment starts becoming useful. A higher return on gross investment is preferable. It is actually an increase in earnings on the previous projects that installed those facilities being allocated to this expansion. Even though both projects on the same site use these facilities the project with the higher return on gross investment uses them with the highest efficiency.

In a large diversified company, this system becomes even more useful because the efficiency at which existing facilities may be used varies widely with different processes.

What Does It All Mean?

A surprising number of businesses still figure their investment requirements for a project as only the capital costs of buildings and equipment. Of course these costs are important, but approval of a project is in a larger sense an appointment of several assets of the company to the purpose of the project.

For example, working capital must be supplied for such items as accounts receivable and inventories; existing company facilities may be used; excess capacity may be included in parts of one project and not another; and expenditures may be required.

For the protection of the stockholders all these items as well as the direct investment should be considered by management in weighing one project against another.

Including the appropriate items will show that the cash requirement is 5 to 10% and the gross investment 10 to 20% larger than the direct investment. This latter increase is not an additional outlay in cash but represents the use of existing company assets other than cash. Since most projects use such assets, the gross investment for these projects is greater than the cash requirements.

It is not only important to know ahead of time the actual assets that will be used in a project, but in comparing projects, it is necessary to know to what degree. By selecting those that yield the highest return on gross investment, the board of directors will compound the greatest amount of assets at the highest rate. Thus the directors are assuring the fastest possible growth for their company. This compounding effect determines the rate at which invested money is repaid and becomes available for reinvestment.

Equilibrium Constants via Nomograph

Published values of reaction equilibria are scanty and restricted. This article extends these data in easy-to-use nomographic form.

NORBERT W. LUFT
Cheshire, England*

PREDICTION of equilibrium concentrations for the components of a reaction system is one of the important steps in the development and design of chemical processes and industrial plants. This knowledge is indispensable for assessing the possible degree of conversion and for calculating mass and energy balances.

Therefore, it's desirable for chemical engineers to have at their disposal values of equilibrium constant, K_p, which are both comprehensive and easy to use.

Unfortunately, relevant thermodynamic data available in our standard texts and data books[1, 2] are restricted and very scanty. For instance, even the latest edition of Perry's handbook gives values for only eight equilibrium constants in graphical form, that is as a plot of log K_p vs. T in deg. K.

Apart from its severe limitations as far as scope is concerned, this graph (Fig. 38, p. 350 of Ref. 1) is very small and it's difficult to read with any degree of accuracy.

For these reasons, we considered it worthwhile to collect and supplement data on reaction equilibria and to present the material in the form of the simple-to-use nomograph shown on the next page. Reactions considered are listed in the table at the left. Included are a wide range of gas-phase equilibria which are important in industrial processes.

In addition to reactions of general interest in organic chemistry,[3, 4, 5] data are included on the thermodynamics of processes that are significant in these fields of application:

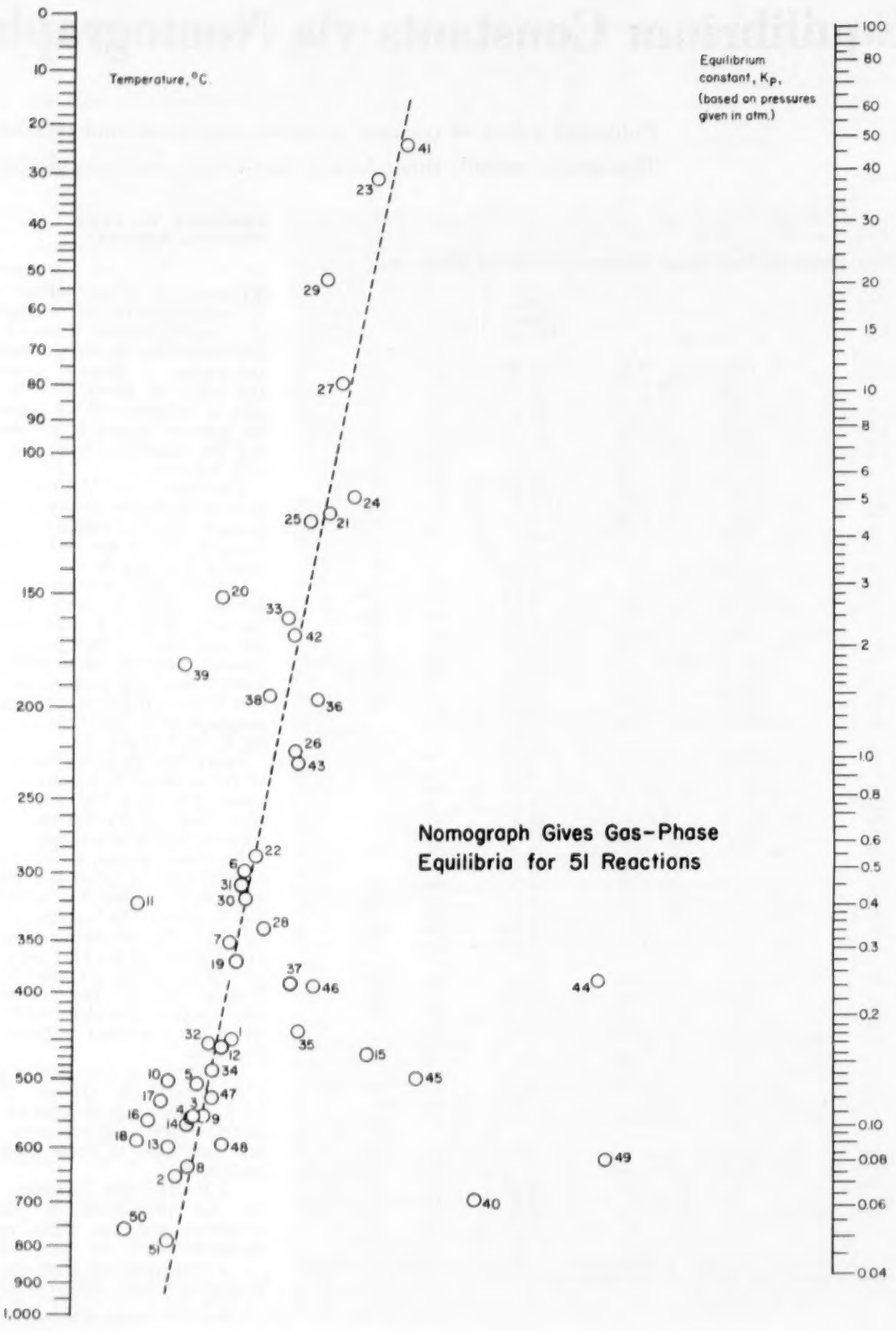
- Hydrocarbon cracking[6, 7, 8, 9] for the production of olefins, aromatics and for other petrochemicals.[10, 11]
- Hydrogen and synthesis gas production[12] and allied processes

*Meet your author on p. 327.

Nomograph on Next Page Incorporates These Reactions

No.	Reaction	ΔH_{298}, Kilocal., Per Mole	T^*, Deg. C.	Ref.
1	$CH_4 = (C) + 2H_2$	17.89	560	22
2	$C_2H_6 = C_2H_4 + H_2$	32.73	805	(22)
3	$C_2H_6 = C_2H_2 + H_2$	29.70	670	(22)
4	$n\text{-}C_4H_{10} = 1\text{-}C_4H_8 + H_2$	30.09	675	(22)
5	$i\text{-}C_4H_{10} = i\text{-}C_4H_8 + H_2$	28.24	610	(22)
6	$C_2H_6 = C_2H_4 + CH_4$	19.43	325	(22)
7	$n\text{-}C_4H_{10} = C_2H_6 + C_2H_4$	22.07	400	(22)
8	$C_3H_8 = C_2H_2 + CH_4$	31.42	790	(22)
(9)	$1\text{-}C_4H_8 = C_4H_6 + H_2$	26.47	690	..
(10)	*cyclo* $\text{-}C_6H_{10} = C_4H_6 + C_2H_4$	40.1	570	(28)
11	$n\text{-}C_6H_{14} = C_6H_6 + 4H_2$	59.78	335	(22, 33)
(12)	$C_4H_6 \cdot C_2H_2 = C_6H_6 + C_2H_4$	25.2	560	..
13	$(C) + CO_2 = 2CO$	41.22	710	22
14	$(C) + H_2O = CO + H_2$	31.38	680	22
15	$CO_2 + H_2 = CO + H_2O$	9.84	780	22
16	$CH_4 + H_2O = CO + 3H_2$	49.27	630	22
17	$CH_4 + 2H_2O = CO_2 + 4H_2$	39.43	600	22
18	$CH_4 + CO_2 = 2CO + 2H_2$	59.10	650	22
19	$CH_3OH = H_2CO + H_2$	19.3	430	30, 34, 35
20	$CH_3OH = CO + 2H_2$	21.68	137	34, 35
21	$C_2H_5OH = C_2H_4 + H_2O$	10.64	82	35
22	$C_2H_5OH = CH_3CHO + H_2$	16.48	310	35
23	$n\text{-}C_3H_7OH = C_3H_6 + H_2O$	8.25	−30	..
24	$n\text{-}C_3H_7OH = C_2H_5CHO + H_2$	9.38	70	..
25	$i\text{-}C_3H_7OH = C_3H_6 + H_2O$	12.48	89	..
26	$i\text{-}C_3H_7OH = CH_3COCH_3 + H_2$	13.61	220	..
(27)	$n\text{-}C_4H_9OH = 1\text{-}C_4H_8 + H_2O$	10.29	30	..
(28)	$HOC_2H_4OH = (CH_2)O + H_2O$	18.6	390	..
(29)	$(CH_2)_4O = C_4H_8 + H_2O$	11	(0)	..
30	$CH_3COCH_3 = H_2C : CO + CH_4$	19.3	350	26
(31)	$C_2H_5Cl = C_2H_4 + HCl$	15.5	360	(22)
32	$H_2C : CHCl = C_2H_2 + HCl$	24.9	540	(22)
33	$CH_2CHCl_2 = H_2C : CHCl + HCl$	14.1	140	(22)
34	$COCl_2 = CO + Cl_2$	26.88	590	30
35	$Cl_2 + H_2O = 2HCl + \frac{1}{2}O_2$	7.67	600	18
36	$2NH_3 = N_2 + 1.5H_2$	10.45	185	22
37	$NO_2 = NO + \frac{1}{2}O_2$	13.15	500	35
38	$HNO_3 = NO_2 + \frac{1}{2}H_2O + \frac{1}{4}O_2$	13.45	185	35
39	$CH_3NH_2 = HCN + 2H_2$	37.9	175	..
40	$CH_3NH_2 + H_2O = CH_3OH + NH_3$	5.95	>2,000	35
(41)	$HCONH_2 = CO + NH_3$	7.8	−50	29
42	$HCOOH + NH_3 = HCN + 2H_2O$	12.7	150	..
(43)	$HCONH_2 = HCN + H_2O$	18.04	232	29
44	$CH_3CN + H_2O = CH_2NH_2 + CO$	3.7	(2,000)	..
45	$C_6H_5NH_2 + H_2O = C_6H_5OH + NH_3$	.....	1,100	32
46	$2H_2S + SO_2 = 1.5S_2 + H_2O$	6.05	525	19
47	$\frac{1}{8}S_8 + 2H_2O = 2H_2S + SO_2$	27.81	650	35
48	$SO_2 = SO_2 + \frac{1}{2}O_2$	23.52	790	37
49	$CS_2 = (C) + S_2$	−1.2	>2,000	20
50	$CH_3SH + H_2S = CS_2 + 3H_2$	52.0	870	(36)
51	$2COS = 2CO + S_2$	41.5	∞1,000	20

NOTE—Reactions numbered in parentheses indicate a lower degree of accuracy which, however, may still be used for engineering calculations.


Temperature, °C
Equilibrium constant, K_P, (based on pressures given in atm.)
Nomograph Gives Gas-Phase Equilibria for 51 Reactions

such as Fischer-Tropsch and OXO syntheses.[13]

• Natural gas reforming[14] and utilization.[15, 16]

•Acetylene-based chemistry as developed by Reppe.[17]

• Alkylation, de-alkylation and cyclization.

• Chlorine manufacture by the Deacon process[18] and by organic hydrochlorination.

• Sulfur recovery,[19] carbon bisulfide production,[20] sulfur trioxide formation and related topics.

• Reactions of ammonia, amines and nitriles.

Data for oxidation, chlorination and nitration processes are omitted since such reactions are usually accompanied by considerable heat evolution and an increase in the number of moles.

In our table we have written our reaction equations in such a way that the conversion of left-hand reactants into right-hand products increases as the temperature is raised.

For example, the equilibrium constant K_p (with pressures expressed in atm.) for the reaction

$$C_2H_6 = C_2H_4 + H_2$$

is defined as:

$$K_p = \frac{(p \text{ of } C_2H_4)(p \text{ of } H_2)}{(p \text{ of } C_2H_6)}$$

where p indicates the respective equilibrium partial pressures, and this value of K_p increases with temperature.

For the range of conditions under consideration, the activity of solid carbon, denoted by (C) in the reaction equation, is unity so that the equilibrium constant for the first reaction in the table,

$$CH_4 = (C) + 2H_2$$

is ,simply:

$$K_p = (p \text{ of } H_2)^2/(p \text{ of } CH_4)$$

For Thermodynamic Stability

Also given in the table are the temperatures T^* at which the various equilibrium constants attain the value of unity. This temperature is an indication of the "thermodynamic stability" of the left-hand reactant; and of the ease with which equilibrium may be established by suitable thermal changes —provided that no limiting kinetic factors are operative.

If equilibrium constants are expressed by the usual two-parameter formula,

$$\log K_p = a - (b/T)$$

then the above condition that K_p approaches 1.0 as T approaches T^* results in:

$$T^* = b/a$$

In these formulas T and T^* are measured in deg. K. The ratio b/a in turn is equal to $\Delta H^*/\Delta S^*$, where ΔH^* and ΔS^* denote reaction enthalpy and entropy change, respectively, both at the characteristic temperature T^*.

Enthalpy of Reaction

Enthalpy of reaction, ΔH_{298} at 25 C. is also included in our table, as this is the accepted standard reference temperature. Also, ΔH^* can be calculated from ΔH_{298} and known—or estimated—values of heat capacity.[1, 2, 21]

Values for some of the equilibrium constants were available in the literature, for example those involving only the molecular species H_2, H_2O, CO, CO_2 and CH_4 were taken from a compilation made by the National Bureau of Standards.[22] Other references are given in the table. In addition, a number of equilibrium constants were computed from published values of enthalpy of formation and known or quantum-statistically calculated data of free energy functions.[23]

In a few instances, the data were obtained either by approximation[24] or by a method of increments, of which various modifications have been proposed.[25] Where we have estimated a value, we have shown the reaction number in parentheses in our table. This indicates a lower level of accuracy which, however, may still be sufficient for engineering calculations.

Nomograph for Easy Use

For easiest use of these equilibrium constants we have presented them in the condensed form of a single nomograph. The scales are a logarithmic K_p scale for equilibrium constants, with pressures in atm.; a scale of inverse absolute temperature graduated in deg. C.; and one reference point for each reaction.

To obtain the value of the equilibrium constant for any reaction listed in the table, connect the appropriately numbered point with the given temperature. The point of intersection with the K_p scale is read as the required value of the equilibrium constant.

Points for equilibria of the general form

$$A = B + C$$

lie close to the dashed line on the nomograph. This circumstance can be used to obtain, for a range of temperatures, approximate values of other equilibrium constants not listed in our table. This can be done either when only one experimental K_p value is known at a single temperature, or by means of T^* as described above.

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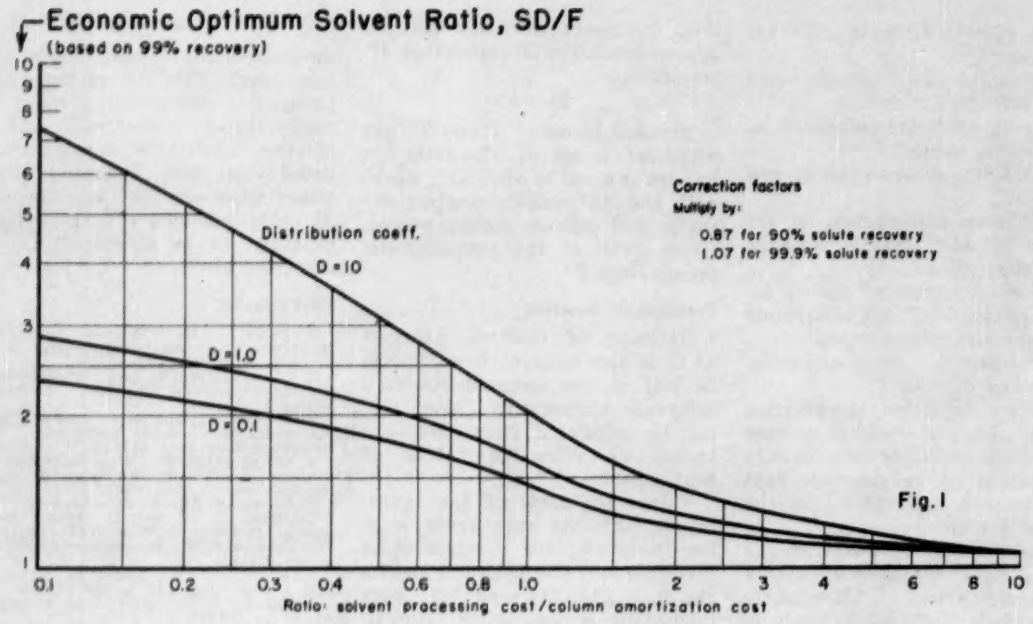


Fig. 1

How to Design Optimum Extraction

E. G. SCHEIBEL, York Process Equipment Corp., West Orange, N. J.*

VERY little consideration has been given to the economics of process design for a continuous liquid extraction operation.

Extraction columns have been installed on the basis of an arbitrary selection of solvent ratio or number of theoretical stages.

A process design engineer can select a large solvent ratio to obtain a given recovery of solute from a feed solution in a small number of stages, or he can select a solvent ratio close to the minimum to get the same recovery in a large number of stages.

In the first case an excessive quantity of solvent will require a column of minimum height but with an excessively large cross-sectional area to handle the solvent. In the second case an excessively small solvent quantity will require a minimum cross-sectional area but an excessive height to provide the necessary number of theoretical stages.

In both cases the limiting condition requires a column of infinite volume; between these limits the column size passes through some minimum value. Since the cost of an extraction column varies with its height and diameter, there is some column design which represents a minimum investment.

It is our purpose here to discuss the factors involved in selecting the economic optimum design for an extraction column and to present the results of a general correlation developed for the extraction unit giving minimum total operating charges.

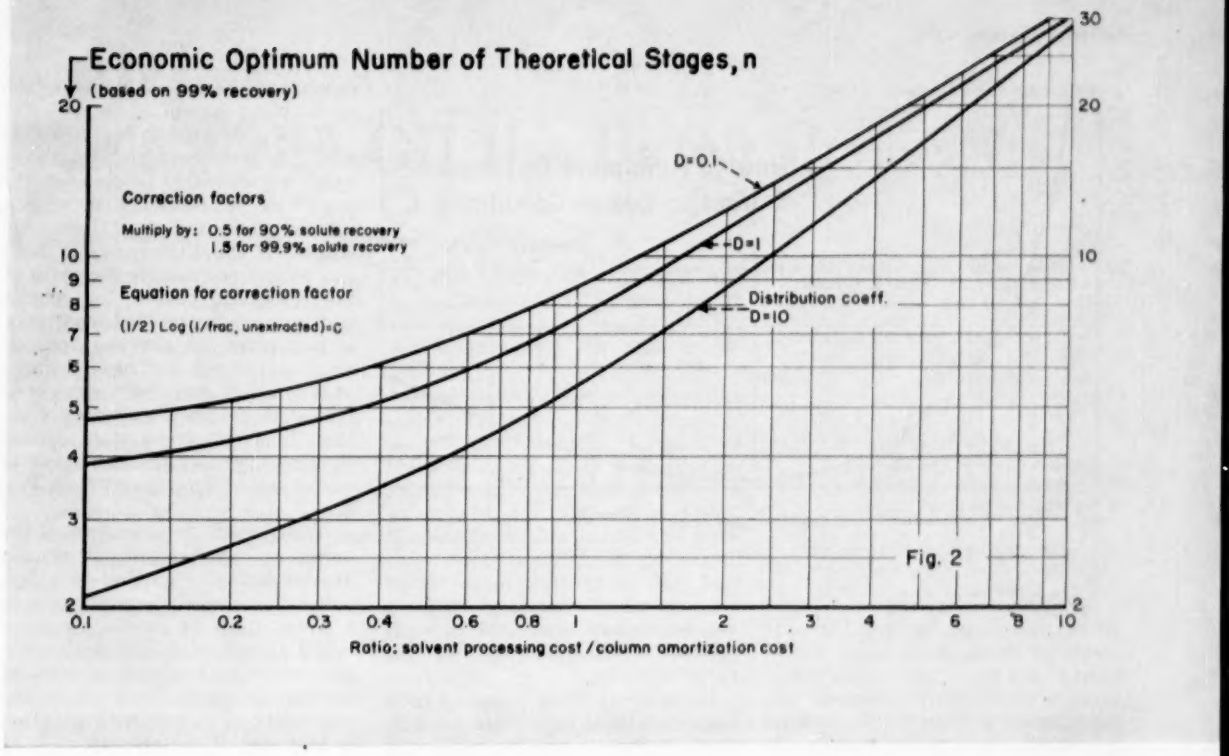
Correlations have been based on assumed relationships between equipment costs and throughput which are reasonable for most cases. They indicate that economic optimum design requires considerably more theoretical stages than generally used.

Over a limited range the cost of an extraction column may be considered proportional to its cubical contents or volume. Process design which requires a minimum volume extraction column in this case would represent the column requiring minimum initial investment.

This does not take into account processing cost of the extract solution: in most cases greater than amortization and maintenance costs on the extraction column.

A qualitative discussion of processing costs has been given by the author as applied to the selection of an economic optimum reflux ratio for a fractional liquid extraction operation.[2] In fractional liquid extraction processing, factors are generally so complex it is not possible to make a quantitative generalization which would be applicable to more than a few cases. However, in the simple extraction of a solute from a feed solution into a solvent, it is possible to develop generaliza-

* Meet your author on page 326.



Columns for Minimum Over-All Cost

tions which can be applied to most cases.

Factors affecting the number of stages in the optimum design are:

- Distribution coefficient of solute.
- Degree of removal of solute from feed.
- Solvent ratio.
- Cost of extraction column.
- Cost of processing the extract to recover the solute.

Let's Derive Equations

The following definitions and assumptions have been made in arriving at the correlation:

1. Distribution coefficient, D is constant and independent of concentration.

2. Total throughput capacity of an extraction column is only dependent upon cross sectional area and independent of solvent ratio.

3. Number of theoretical stages in an extraction column is proportional to height and independent of diameter.

4. Cost of an extraction column is proportional to its volume.

5. Processing cost for the extract is proportional to the volume of solvent and independent of the amount of solute in the extract.

All of these assumptions may be subject to discussion. However they will hold over a limited range and if this range includes the economic optimum design the derivation will be rigorous. A method for evaluating the proper proportionality constants to cover this range will be discussed later.

For a constant distribution coefficient the relationship between degree of extraction, solvent rate, feed rate, distribution coefficient and number of theoretical stages is well known.[1]

$$\frac{x_n}{x_o} = \frac{(SD/F) - 1}{(SD/F)^{n+1} - 1}$$

where x_o = concentration of solute in feed solution; x_n = concentration of solute in raffinate after n countercurrent stages; S = rate of solvent flow; F = rate of feed; D = distribution coefficient (conc. in solvent/conc. in raffinate phase); n = number of theoretical extraction stages.

Numerous curves showing these relationships have appeared in the literature.[1]

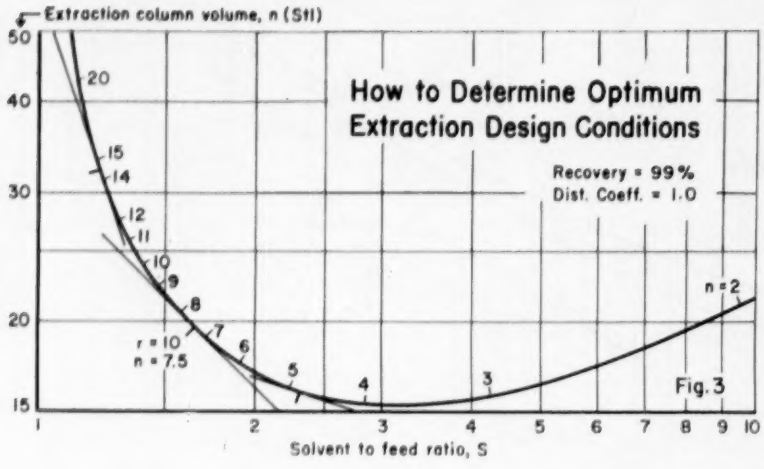
Assumptions (2) (3) and (4) may be combined to show cost of an extraction column to be proportional to $n\ (S + F)$. If amortization and maintenance cost is considered proportional to investment cost, the cost of the extraction column per unit quantity of product is

$$C_e = \alpha n\ (S + F) \qquad (1)$$

where α is a proportionality constant.

The processing cost of the solvent according to assumption (5) is given as

$$C_p = \beta S \qquad (3)$$



where β is the proportionality constant. It should include any increment in the amortization and maintenance required by increased solvent handling capacity, as well as the utilities and labor actually involved in recycling the extraction solvent.

An economic optimum design is obtained when the sum of $C_s + C_p$ is a minimum. This occurs when $dC_s = -dC_p$. If the ratio of the processing cost to the extraction column cost at the optimum design conditions is designated r,

$$r = \frac{C_p}{C_s} = \frac{\beta S}{n\alpha\,(S + F)} \qquad (4)$$

Then minimum cost occurs when

$$\frac{d\log[n(S + F)]}{d\log S} = -r \qquad (5)$$

Since the solution of Eq. (5) depends upon the ratio of solvent to feed rather than the absolute values of either, F can be taken as unity and S would then be the ratio of the solvent rate to the feed rate and the relationship becomes

$$\frac{d\log\,[n(S + 1)]}{d\log S} = -r \qquad (6)$$

Graph Economic Values

For a given distribution coefficient and degree of removal of solute, the value of S can be determined from the graphs of Eq. (1) at different values of n. Plotting the product of $n\ (S + 1)$ against S on log-log graph paper gives a curve as shown. Values of n and S are determined where the curve is tangent to a line of slope $-r$ *(see curve above)*.

Location of these tangents have been correlated for different conditions in Figs. 1 and 2.

Fig. 1 shows the optimum solvent ratio as a function of r for 99% recovery of solute and for different distribution coefficients. The distribution coefficient has been incorporated in the ordinate to allow the curves to fall within the same cycle on the log plot. This also facilitates interpolation at intermediate distribution coefficients. Correction factors for different degrees of recovery are shown on the figure.

Fig. 2 shows the correlation of the optimum number of stages as a function of r at different distribution coefficients and for 99% recovery of solute. Correction factor is 0.5 for 90% recovery and 1.5 for 99.9% recovery. The factor for intermediate recoveries can be estimated by calculating the correction factor with the equation given on the figure.

Calculate the Economics

These curves can be used to examine the economics of existing equipment as well as for establishing the economic optimum design in new installations.

In an existing installation ratio of the processing to equipment cost can be calculated from the operating data and the optimum number of stages determined from Fig. 2. This can be compared with the number of theoretical stages in the actual plant column.

If the plant column contains considerably less theoretical stages it would be advisable to consider the economics of replacing it with a column containing more theoretical stages. If the discrepancy is large you should re-evaluate the ratio of the processing cost to the column cost at the new proposed conditions. If this ratio has changed appreciably revise the optimum number of theoretical stages accordingly as indicated by the new value from Fig. 2. The solvent ratio corresponding to the optimum number of stages can be determined from Fig. 1.

As an alternate procedure, if the optimum number of stages is greater than the number provided, you can increase the feed rate to a given unit by employing additional stages in the extraction column while maintaining a constant solvent quantity. This offers the possibility of increasing production in this step of the process while at the same time obtaining a more economic operation.

To use these figures for the design of a new extraction system, a preliminary estimate must be made of the ratio of the processing cost to the extraction column cost. This could be done on the basis of a preliminary estimate and a solvent ratio and number of theoretical stages selected from the curves of Figs. 1 and 2.

Ratio of the costs would be evaluated for the selected operating conditions and a new optimum set of conditions selected if necessary. When the calculated cost ratio does not require a solvent ratio appreciably different from the previously assumed value the design can be accepted as final.

Note that when the distribution coefficients are not constant the number of stages actually calculated at the chosen solvent ratio will be different from that given by the correlation. For these cases the actual calculated number of stages must be provided. Usefulness of Fig. 2 is primarily for evaluating the performance of existing extraction units.

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BATCH VS. CONTINUOUS

Don't Write Off the Batch Process

J. R. DONOVAN, Monsanto Chemical Co., Monsanto, Ill.*

IN DESIGNING new chemical production facilities or changes to existing units, a choice between batch and continuous processing must usually be made. It is desirable to base this decision on a careful comparison of the merits of the two processing methods, and not on opinions or beliefs. This article presents a generalized analysis of the economics of batch versus continuous processing, illustrated by specific examples from the literature. The operating advantages and disadvantages of each type of operation are compared.

Consider what is meant by a continuous process. Generally, this is taken as corresponding to continuous feed of raw materials and discharge of products, as compared to intermittent feed and discharge in a batch process. A continuous process may be either an uninterrupted flow type, in which accumulations of matter do not occur at any point, or may be "stagewise," in which local accumulations occur. Klinkenberg[1] proposes the term "gradual" for continuous-flow processes which are not "stagewise." "Gradual" processes may be analyzed mathematically by the differential calculus, whereas, "stagewise" processes may require other methods.

"Gradual" continuous processes are generally confined to gas-phase reactions like those found in the petroleum industry. Other familiar examples are the contact process for sulfuric acid, the synthesis of ammonia from nitrogen and hydrogen, and the catalytic oxidation of ammonia to nitric acid. In the ideal case, each particle of raw material will receive exactly identical treatment with every other particle of the same raw material.

Most continuous processes dealing with liquids or solids are of the "stagewise" type. As an example, consider liquid-phase alkylation as carried out in the petroleum and chemical industry. This operation is normally performed by feeding raw materials continuously into an agitated vessel which contains a cooling surface. A product stream is continuously withdrawn, which in some cases may pass to another alkylation vessel for further reaction.

If we assume that mixing in the alkylation vessel is fairly rapid, it is evident that some particles of the feed material will leave the reaction vessel after a very short sojourn time. It can also be seen that the continual dilution of the reaction mass with fresh feed will cause some particles of the feed material to remain in the reaction vessel for a very long time—infinitely long in the case of perfect mixing.

As a result of this variable sojourn time, some particles of feed will pass out of the alkylation vessel before they have reacted, and some particles may remain so long that they react too far and form unwanted byproducts. It is evident that the amount of reaction which can be obtained in a system of this kind will always be less than theoretical and that its exact value will depend upon the speed of reaction and the ratio of vessel size to rate of feed. In estimating the extent of reaction, it is customary to assume perfect mixing. This assumption gives fairly reliable values for most reactions when a properly designed mixing system is used.

The effect of using two or more stagewise reaction vessels in series has been extensively treated in the literature, two recent articles being those of Weber[2] and Acton and Lapidus.[3] Sherwood[4] has discussed the effect of variable residence time in relation to mixing efficiency. As a rough approximation, it is sometimes useful to assume that the same percentage reaction is obtained in each vessel of a series.

For example, if a reaction is 90% complete in the first vessel of a series, 90% reaction of the unreacted component may be assumed in the second vessel. The amount of unreacted material in the discharge from the second vessel will consequently be 10% of 10%, or 1%. The over-all extent of reaction for the two vessels in series is thus 99%. Obviously, this is only an approximation, since most reactions slow down as the concentration of reactants decreases and the concentration of products increases.

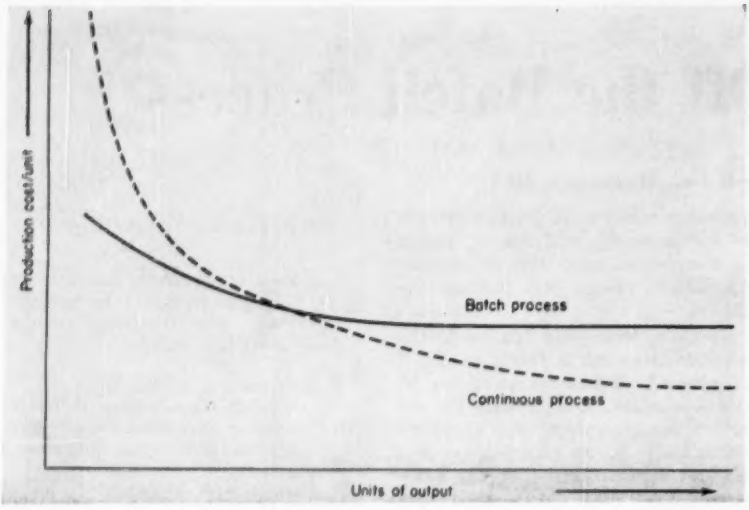
Both Have Advantages

- **Complexity and Cost**
  Batch processes in general are less complex, usually cost less to build.
- **Output vs. Advantage**
  Small outputs tend to favor batch processes, large outputs, continuous processes.
- **Production Volume**
  Continuous processes usually make more product per unit of equipment and, in larger plants, more product per dollar invested.
- **Versatility**
  Batch processes are more versatile, can be adapted more easily to the making of other products.
- **Controllability**
  Continuous processes can use simpler instrumentation but control needs of batch processes are less stringent owing to "flywheel effect."
- **Yield**
  Batch processes usually give slightly better conversion and yield except where unstable products or unfavorable side reactions exist.
- **Reaction Speed**
  Fast reactions tend to favor continuous processes, slow reactions, batch processes. Reaction may even be too slow for continuous process.

Production Costs

Before considering the economic basis for comparison between continuous processes on the one hand, and batch processes on the other, it

* Meet your author on page 330.



TYPICAL cost comparison of batch and continuous processes. (Fig. 1)

will be helpful if we review for a moment the subject of production costs and their variance with volume of output. In general, for any given process the greater the volume of production, the lower is the cost of producing one unit of output. However, this variation is not linear, and will tend to approach some limiting value asymptotically. The magnitude of this limiting cost will, of course, be different for different processes, and can be lowered by changes or improvements to the process.

A curve which plots unit cost versus volume of output will have a hyperbolic shape because some total costs are relatively fixed regardless of output, thus causing unit costs to vary inversely with volume. Other costs vary almost directly with production rate (i.e., are constant unit costs), thus fixing the asymptote. The major cost items in each category are shown in the adjoining table.

The components in category *B* will naturally have different values in plants of different sizes. However, their magnitudes cannot be indefinitely reduced by increasing plant size to larger and larger capacities. There are limits to the size of equipment which can be economically installed and repaired, and the "law of diminishing returns" also begins to take effect, with factors such as flexibility, freight rates, and the like, assuming increasing importance. When this point has been reached, increased output is obtained by duplicating the processing system, frequently in another location. Obviously, this will not provide lower unit costs unless unusual location advantages are obtained.

Major Components of Unit Production Cost

A. Components not affected appreciably by volume

1. Raw materials
2. Utilities (steam, power, water, etc.)
3. Analytical costs

B. Components which tend to vary inversely with volume

1. Labor and supervision
2. Repair and maintenance
3. Depreciation, insurance, taxes, etc.

Economic Comparison of Processes

In general, we can state that a plant employing a continuous process will require more individual types of components of equipment than a plant using a batch process for the same product. On the other hand, it is almost invariably the case that a greater volume of production can be obtained from a continuous plant than from a batch plant having the same amount of equipment.

To illustrate these statements, consider a plant designed to produce chlorophenol by reacting chlorine gas with phenol, followed by fractionation of the reaction mass.[5, 6, 7] If this plant is to operate batchwise it will be necessary to have only one chlorinator, one fractionating column, and an appropriate number of fraction receiver tanks. However, if the process is to be operated continuously, it will undoubtedly be necessary to have two chlorination vessels in series, plus one fractionating column for each component.

In this particular case, a total of at least four columns will be required, one for unreacted phenol, one for orthochlorophenol, one for 2,4-dichlorophenol, and one for parachlorophenol. Each column will, of course, have to have a separate reboiler, circulating pump, condenser and instruments.

It is evident that the continuous plant is considerably more expensive and complex than the batch plant, assuming that one batch reactor and still have adequate capacity. However, if identical dollar amounts of equipment are provided in a larger capacity plant, a continuous unit will be capable of greater output than a batch plant. This situation arises because the batch plant requires a certain amount of valuable processing time to charge and discharge each vessel, and to heat and cool the contents. In addition, batch fractionation requires intermediate cuts or fractions to be taken, which must be recycled through the process.

The general conclusion may be drawn that batch processes are more attractive economically at low production rates, whereas at high production rates continuous processes are preferred. The situation is shown graphically in Fig. 1.

For evaluation purposes, return on investment generally is used as the criterion rather than production cost. The basic conclusion will not change, however. A given continuous process may show a lower production cost than a batch process, yet may not yield as great a return on the investment because of high plant costs. However, as capacity is increased, the continuous process will eventually reach a point of better return on investment than the batch process.

It is evident, of course, that the phrases "high production volume" and "low production volume" are wholly relative. The point of equiv-

alence between batch and continuous processes may vary widely depending upon the particular process under consideration. For example, it is conceivable that certain high-value pharmaceuticals might never reach the point where continuous processing would become attractive. A few grams, or pounds, lower yield of one of these products might represent several hundred dollars of cost.

Since batch processes generally give slightly better conversions and yields than continuous processes, a batch process would be preferred in these cases at any realistic production volume. If any general rule can be formulated it is this: evaluate each case on its individual merits.

Advantages and Disadvantages

Unfortunately, many people have the false idea that batch processes are inefficient, antiquated, and outmoded. The batch process still has its place in chemical industry, and will continue to have it for the foreseeable future. It is generally the first step in the development of any process, and frequently continues as the preferred process if production demand is not too high. In addition to being more economical at low production rates, it has the following advantages as compared to the continuous process:

1. Each operation is separate and not a link in a chain as in the continuous process. Consequently, accidental breakdowns or stoppages are not as serious.

2. Batch process equipment is generally more versatile than continuous equipment. Therefore it is more easily altered to meet changing process conditions—or a complete change in product—if desired.

3. Precise control of batch operations is generally not as important as control of continuous operations. If the process temporarily deviates from desired temperatures, pressures, etc., it can usually be corrected without much harm. A continuous process, however, may produce fairly large amounts of off-quality goods under the same circumstances.

4. Certain reactions which are of high kinetic order, or are relatively slow, can be carried out with satisfactory yields only in a batch process.

As opposed to these arguments, there are sometimes good reasons for adoption of a continuous process, even though the necessary equipment may be complicated or costly. Some of these reasons include:

1. In cases where unstable products or intermediates exist, continuous processing usually gives better yield and quality owing to shorter exposures to critical conditions. In other cases, unfavorable side reactions are minimized.

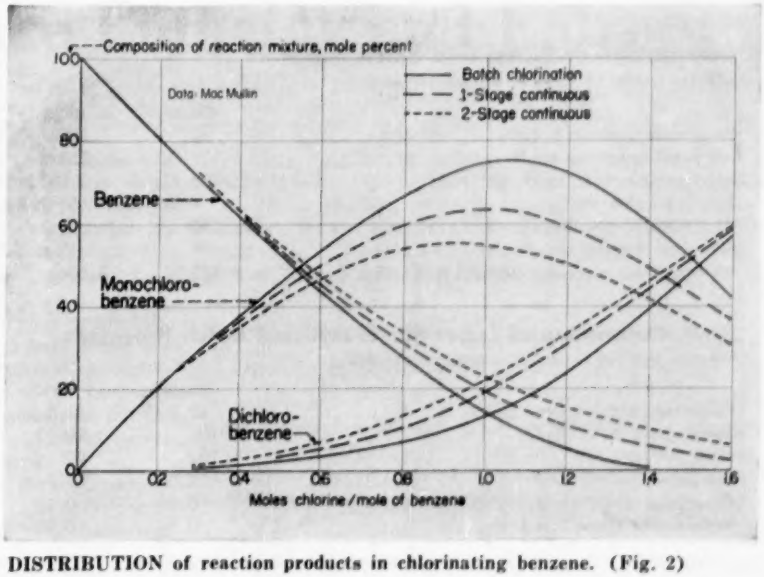
2. A continuous process may give appreciable equipment savings in the case of a fast reaction which evolves or absorbs considerable heat. Under these circumstances, almost complete reaction can be obtained in one or two small vessels operated continuously—plus added heat exchangers, if necessary. The greater ratio of surface to volume which can be obtained in the small vessels in comparison with one large batch reactor permits a greater amount of heat to be transferred per unit volume, thus increasing production rate.

Furthermore, the rate of heat release or absorption in a batch process is generally much greater at the beginning of the reaction than at the end. Consequently, batch heat exchangers must be sized for maximum duty, rather than average, as in the continuous process.

3. Automatic control of continuous processes can be achieved with fairly simple standardized instruments, whereas control of batch processes is more difficult. Automatic control in turn reduces labor cost and gives a more uniform product.

The difference in case of instrumentation arises because every vessel or control point in a continuous process normally has some given value of process variable, such as temperature, pressure, level or pH which is to be maintained at all times. This is a job which can usually be taken care of by relatively simple instrumentation. However, conditions, in the batch process are different from minute to minute, a situation which is harder to handle. Automatic cycle controllers are sometimes used for batch operations, but they are normally not able to compensate for unforeseen deviations from desired conditions.

At first glance, it might appear that the preceding remarks about ease of automatic control contradict the earlier statement regarding the greater necessity for precise control in continuous processing. In reality, there is no contradiction. What we are talking about with respect to precise control is the relative stability of operation obtained in batch systems as a result of the larger masses of material present. A change in external conditions changes batch process vari-



DISTRIBUTION of reaction products in chlorinating benzene. (Fig. 2)

ables quite slowly because of this "fly-wheel" effect.

Continuous processes, on the other hand, have relatively little "flywheel" effect. Generally they have rather poor characteristics in relation to the time required to achieve steady-state conditions. This means that any changes in external conditions immediately affect the continuous process. Once the process is disturbed, a relatively long time is required to bring it back to the desired control point.

For further discussion of the operating advantages and disadvantages of each type of operation, the symposium published in *Chemical & Metallurgical Engineering* in May 1945[8] should be consulted.

Example: Chlorination of Benzine

Having thus summarized the main factors in general terms, let us examine some specific examples of batch and continuous operation as used for the same process. R. B. MacMullin[9] has given us a good illustration of the variation in reaction products obtained by batch versus "stagewise" continuous chlorination of benzene.

The results of the work are best presented graphically, as shown in Fig. 2.

The conclusions drawn by Mr. MacMullin are as follows:

1. "Continuous chlorination results in a greater proportion of higher chlorinated products than batch chlorination, at all mole ratios of chlorine to benzene. Continuous chlorination is therefore less favorable than batch chlorination at any given mole ratio of chlorine to benzene, but can be made as favorable by chlorinating to some lower mole ratio and recycling the underchlorinated material after isolation of the desired product.

2. "Two-stage chlorination gives a distribution of products intermediate between single stage chlorination and batch chlorination. . . . The greater the number of stages, the closer the approach to batch distribution."

We should note that this analysis is based entirely on relative rates of reaction, assuming that any desired degree of chlorination can be obtained in a given vessel. It does not consider questions of absolute reaction rate, heat transfer, gas disengaging surface, ratio of vessel capacity to continuous feed rate, etc. Consequently, it is not adequate in itself for a complete economic evaluation, even though entirely valid for the given conditions. It is presented here to illustrate the general yield picture.

Example: Nitration With Mixed Acid

Another example recently described in the literature is the manufacture of nitroglycerine (or other nitro compounds) by the Biazzi continuous process, as contrasted to the conventional batch process. A good comparison is given in an article by H. J. Klassen and J. M. Humphrys[10] from which the following information is taken:

In addition to the factors shown in the tables, the article states that utilities required for the Biazzi process are considerably less than for the average batch process. Water requirements are said to be about half those for the batch process and refrigeration requirements are about 25% lower. The authors give no estimates of capital investment, but it appears probable that because of specialized construction and materials, equipment costs may be somewhat higher for the Biazzi process, with a possible compensating factor in a smaller investment in buildings and supporting steel work.

In this particular case there is no doubt that the continuous process is more desirable for normal production volumes, in part because the unstable nature of the product makes the smaller inventory and better temperature control of the continuous process very attractive from a safety standpoint.

To summarize, we have seen that batch processes are more economical than continuous processes at low production rates, and less economical at high production rates. The point of equivalent economic return may vary widely from one process or product to another, and must be individually determined for each specific case. In general, batch processes exhibit slightly higher conversions and yields, are more versatile, and are less susceptible to minor process upsets than continuous processes. Continuous processes are more efficient from the standpoint of equipment utilization, are more amenable to automatic control, and may offer better yield or quality in the case of certain sensitive reactions.

Comparison of Biazzi and Batch Nitrators

(Basis: Output of 2,500 lb. nitroglycerine/hr.)

	Biazzi	Batch
Nitrator capacity, U. S. gal	32	810
Total cooling surface, sq. ft	122	258
Unit cooling surface, sq. ft./gal	3.81	0.32
Time in nitrator, min	4.2	50
Heat transfer, Btu./(sq. ft., hr., °F.)	150	69
Brine inlet temperature, °F	28	−13 to −3
Nitroglycerine in nitrator (at 4.7:1 acid ratio), lb	170	3,500

Raw Materials and Labor for Biazzi and Batch Processes

(Basis: Per 100 lb. dry nitroglycerine produced.)

	Biazzi	Batch
Glycerine (50% ethylene glycol), lb	42.8	42.8
Sulfuric acid, lb.*	101	99
Nitric acid, lb.*	104	99
Sodium carbonate, lb	8.0	1.7
Operating labor, man-hr	0.09	0.18
Maintenance labor, man-hr	0.04	0.08

*Gross input as 100% acid. No allowance for recovery of spent acid.

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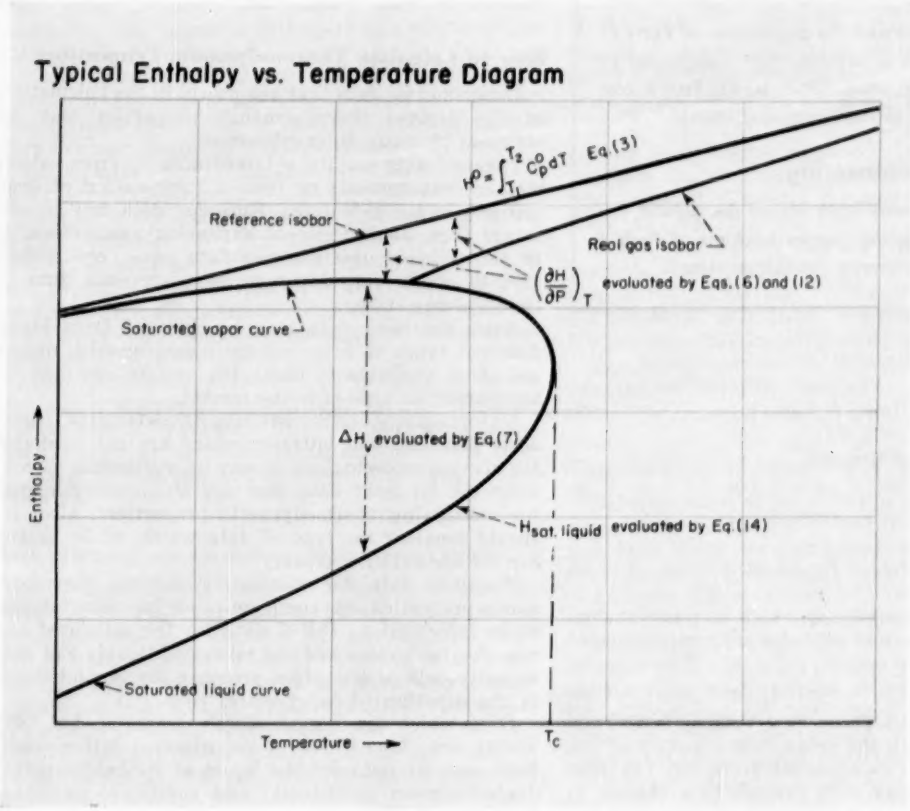
Thermodynamic Properties of Pure and Mixed Hydrocarbons—III

Continuing a series from *Petroleum Processing*



Pure Substance Enthalpy and Entropy

MERK HOBSON and JAMES H. WEBER, Univ. of Nebraska, Lincoln, Nebr.*

Derived thermodynamic properties of enthalpy and entropy are useful tools of the process design engineer. In calculations as varied as the determination of a compressor work load or the determination of the heat which must be supplied in the reboiler of a distillation column, the process design engineer uses these thermodynamic properties.

Because of the extensive use of derived properties, it's worthwhile to consider the physical data which are required for their determination; to review the rigorous and the generalized methods by which they are determined; to compare the results obtained by the two methods; and to point out the thermodynamic data which are available in the literature.

While there are a number of other derived properties, such as internal energy, Gibbs' free energy and Helmholtz's free energy, the scope of this discussion will be limited to the enthalpy and entropy functions. Because these are the most commonly used properties.

To limit the discussion further, we will only consider in this article the derived properties of pure substances. Derived properties of mixtures (Part IV of this series) will be discussed in an early issue.

* Meet your authors on pp. 332 and 328.

How Enthalpy Is Defined Thermodynamically

The defining equation for enthalpy is:

$$\Delta H = \Delta E + \Delta PV \quad (1)$$

This expression is perfectly general and may be applied to any change of state. However, it can be simplified for certain specific processes.

Considering a constant pressure process,

$$(\Delta H)_P = \Delta E + P\,\Delta V \quad (2)$$

and if no phase change is involved,

As a Service to the Readers of . . .

. . . *Petroleum Processing*

We have undertaken the publication of Parts III and IV of this series of articles. Part I appeared in *Petroleum Processing*, Aug. 1957, p. 43; Part II can be found on p. 153 of the September issue.

. . . *Chemical Engineering*

For those who may have missed the start of this series, we are preparing reprint booklets of Parts I and II. See Reader Service for further details.

$$(\Delta H)_P = \int_{T_1}^{T_2} C_P \, dT \tag{3}$$

For a constant volume process,

$$(\Delta H)_V = \Delta E + V \Delta P \tag{4}$$

and, if no phase change is involved,

$$(\Delta H)_V = \int_{T_1}^{T_2} C_V \, dT + V \Delta P \tag{5}$$

For an isothermal process in which no phase change is involved, the change in enthalpy may be calculated from this expression:

$$(dH)_T = [V - T(\partial V/\partial T)_P]dP \tag{6}$$

Eq. (6) is important because it relates isothermal enthalpy changes with the volumetric behavior of the fluid in question. It is apparent from Eq. (6) that the change in enthalpy with respect to a change in pressure under isothermal conditions for an ideal gas is zero.

For an isothermal change which involves a phase change, such as the vaporization of a pure liquid, the enthalpy change may be calculated from the Clapeyron equation:

$$\Delta H_v = (dP/dT)T(V_g - V_l) \tag{7}$$

A Quick Look at Entropy

We won't attempt a discussion of the theoretical implication of entropy. However, by definition, entropy is an intrinsic property of matter which is uniquely determined by the state of the substance.

If the substance absorbs heat at constant pressure, the entropy change is determined by this equation:

$$\Delta S = \int_{T_1}^{T_2} (C_P/T)dT \tag{8}$$

For an isothermal process in which no change of phase is involved, the entropy change is calculated by this expression:

$$(dS)_T = -(\partial V/\partial T)_P \, dP \tag{9}$$

Eq. (9) shows that the entropy change of an ideal gas under isothermal conditions is not zero. It is equal to

$$-R \ln (P_2/P_1)$$

For an isothermal process which involves a phase change, such as the vaporization of a pure liquid, the entropy change can be calculated from this relationship:

$$\Delta S_v = \Delta H_v/T \tag{10}$$

How to Calculate Thermodynamic Properties

Experimental data that are useful in the calculation of the derived thermodynamic properties may be obtained by many different means.

Thermal data may be obtained directly from calorimetric measurements or from a combination of heat capacity and *P-V-T* data. Enthalpy data may be obtained from Joule-Thomson expansion measurements. In recent years spectroscopic data have been widely used to obtain very accurate thermodynamic data in the ideal-gas state.

Since the basic data may be obtained from many different types of experimental measurements, means are often available to check the results obtained by any particular type of measurement.

Unfortunately, sufficient data to determine rigorously enthalpy and entropy values are not available for many compounds; so, it may be worthwhile to consider the kinds of data that are absolutely essential for calculating thermodynamic properties. Also, we should consider the type of data which, while useful, are not absolutely necessary.

Required data for calculating derived thermodynamic properties are: complete vapor pressure-temperature information; *P-V-T* data for the saturated and superheated vapors and the saturated liquid; and heat capacity data at one given pressure for the substance in the superheated vapor state.

Data which are not absolutely essential, but very useful, are: latent heat of vaporization information; heat capacity data for the liquid at its bubble point; Joule-Thomson coefficients; and additional gas-phase heat capacity data.

Establishing the Complete Network

Assuming that for a given substance the necessary thermal and volumetric data are available and it is of interest to establish the complete thermodynamic network (that is, enthalpy and entropy data) there are, generally speaking, two methods available for carrying out the calculations.

One method is an analytical procedure and requires that the volumetric data of the superheated and saturated vapors be fitted to an equation of state. The second method is a graphical procedure and involves the use of either the residual volume, defined as

$$\alpha = (RT/P) - V_{actual}$$

or the compressibility factor, defined as

$$z = RT/PV$$

We'll review these two methods briefly, with the analytical procedure being treated first.

We Need a Basis and a Datum Point

Before proceeding with the calculations, it's necessary to establish a basis and a datum point. For pure materials, 1 lb. of the substance is usually selected as the basis for calculations and the results are presented

in engineering units; namely, Btu.'s, psia. and deg. F.

The selection of the datum point is a matter of convenience. Some authors set the enthalpy and entropy values of the saturated liquid at the normal boiling point equal to zero. The datum point is usually selected so that negative enthalpies and entropies are avoided.

Since the reference state selected for the American Petroleum Institute's Research Project 44[3] is frequently used—and some of the data reported in this work are very useful in the calculations which will be discussed later—special mention must be made of this important publication.

Included in API Research Project 44 are heat capacity, C_P°, enthalpy, H°, and entropy, S°, data for a number of substances in the ideal-gas state and at unit fugacity. These data have been derived from spectroscopic measurements using statistical methods which yield the energy of the substance in the ideal-gas state referred to 0 R.

From these energy values, it's possible to derive heat capacity, enthalpy and entropy data by the usual thermodynamic relations. This procedure leads to the absolute zero as the most convenient reference temperature. Hence the API 44 values are based on this reference.

Next, Determine Complete Enthalpy Values

After selecting the basis for calculations and the datum point, the next step is the determination of enthalpy values over the complete temperature range and at some constant pressure. Eq. (3) is used for this calculation and the necessary data may usually be obtained from API 44. Then, the effect of pressure on enthalpy must be determined.

When thermodynamic properties of hydrocarbons are calculated analytically, the Benedict-Webb-Rubin equation of state,[4]

$$P = RTd + [B_oRT - A_o - (C_o/T^2)]d^2 + (bRT - a)d^3 + a\alpha d^6 + (cd^3/T^2)[(1 + \gamma d^2)e^{-\gamma d^2}] \quad (11)$$

is usually used. This equation predicts the volumetric behavior of a number of hydrocarbons in the vapor state—superheated as well as saturated—with a high degree of precision.

Of course, it's necessary to have experimental *P-V-T* data to determine the eight empirical constants of the Benedict-Webb-Rubin equation. This equation in the form,

$$H = H^\circ + [(B_oRT - 2A_o - (4C_o/T^2)]d + (2bRT - 3a)(0.5d^2) + 6a\alpha d^5/5 + (cd^2/T^2)\left[\frac{3 - 3e^{-\gamma d^2}}{\gamma d^2} + \gamma d^2 e^{-\gamma d^2}\right] \quad (12)$$

can be used to predict the change of enthalpy with pressure under conditions of constant temperature. The value of the term H° may usually be obtained from API 44.

If the heat capacity for the real gas at atmospheric pressure were available, there would be an additional step in the calculations. This step would account for the deviation from ideal behavior, since even at this low pressure this deviation must be taken into account.

The following equation illustrates, in a general manner, the method of calculation:

$$(H_{14.7} - H_P)_T = (H_{14.7} - H^\circ)_T - (H_P - H^\circ)_T \quad (13)$$

The Problem of Saturated Vapors

Determination of the enthalpy data for a saturated vapor requires that the values of P and T corresponding to a point on the vapor pressure-temperature curve be used in the equation of state.

Accurate representation of the volumetric behavior of a substance along the vapor-phase boundary is often a condition where the most complicated equation of state fails. However, if the equation of state can satisfactorily represent the volumetric behavior along the saturated-vapor curve, then the enthalpy values along the phase boundary can be determined and the vapor-phase calculations completed.

Establishing the Liquid Curve

To establish the saturated liquid curve, without experimental latent heat of vaporization data, requires the use of the Clapeyron equation, Eq. (7).

The volume of the saturated-liquid phase and the slope of the vapor-pressure temperature curve are the only data required for this calculation which were not used in the determination of the vapor enthalpies. Once the latent heat of vaporization is calculated, the enthalpy of the saturated liquid can be calculated by this relationship:

$$H_{sat.\ vapor} - H_v = H_{sat.\ liquid} \quad (14)$$

With these calculations the enthalpy data are complete. The data are usually smoothed on a large-scale enthalpy vs. temperature plot. To help illustrate the method of calculation, we have included a typical enthalpy vs. temperature plot as the frontispiece for this article. On this diagram we indicate the steps involved in the calculations.

When You Have More Than Minimum Data

In the procedure for calculations given above, it has been assumed that only a minimum amount of experimental data is available. However, in some cases more than the minimal data are available.

For example, if latent heat of vaporization data

Nomenclature

C_P	Heat capacity at constant pressure, Btu./lb.-°F.
C_V	Heat capacity at constant volume, Btu./lb.-°F.
d	Density, lb./cu. ft.
E	Internal energy, Btu./lb.
R	Universal gas constant, 1.987 Btu./lb. mole-°R.
S	Entropy, Btu./lb.-°R.
T	Absolute temperature, °R.
V	Volume, cu. ft.
z	Compressibility factor, $z = RT/PV$
α	Residual volume
Subscripts	
c	Refers to critical property
g	Refers to gas phase
l	Refers to liquid phase
R	Refers to reduced property
v	Refers to vaporization
Superscripts	
o	Refers to a property in the ideal-gas state

Note—In the Benedict-Webb-Rubin equation of state, A_o, B_o, C_o, a, b, c, α and γ are empirical constants in the equation.

have been determined calorimetrically, these values would be in the original calculations and the Clapeyron equation would be used as an independent means to check the thermal measurements.

Another excellent means of checking some of the calculated data can be used if heat capacity data of the liquid at the bubble point are available. These data permit the calculation of the enthalpy values for the saturated-liquid phase and afford a check on the results obtained by Eq. (14).

Of course, the more data available, the greater are the opportunities to check any one set of data or calculations. The examples given here are the ones most frequently encountered.

Enthalpies from Different Data Sources

Average values reported, in the indicated pressure range, as Btu./lb. Superscripts indicate sources.

Methane, for x_c = 0.29			
10–30 psia.	H^{18}	H^{17}	H^{16}
−150 F.	− 1.8	− 1.4	− 2.2
− 50 F.	− 1.0	− 0.8	− 1.1
0 F.	− 0.8	− 0.5	− 0.9
100 F.	− 0.6	− 0.4	− 0.7
10–100 psia.			
−150 F.	− 7.8	− 6.8	−10.3
− 50 F.	− 4.5	− 2.9	− 4.9
0 F.	− 3.4	− 2.2	− 3.9
100 F.	− 2.5	− 1.6	− 2.7
10–300 psia.			
−150 F.	−29.0	−29.0	−43.1
− 50 F.	−15.5	−11.2	−16.6
0 F.	−12.2	− 5.3	−13.1
100 F.	− 8.0	− 3.5	− 8.9
1-Butene, for x_c = 0.27			
14.7–50 psia.	H^{18}	H^{17}	H^{16}
140 F.	− 3.1	− 3.9	− 6.3
340 F.	− 1.7	− 1.5	− 1.7
480 F.	− 1.2	− 1.0	− 1.3
14.7–300 psia.			
140 F.	———	———	———
340 F.	−16.4	−14.4	−14.8
480 F.	−10.1	− 8.9	−10.8
14.7–500 psia.			
140 F.	———	———	———
340 F.	−32.5	−28.6	−29.0
480 F.	−18.5	−17.1	−18.6
Benzene, for x_c = 0.269			
14.7–50 psia.	H^{18}	H^{17}	H^{16}
300 F.	− 3.6	———	− 4.8
400 F.	− 2.7	− 2.4	− 3.0
600 F.	− 1.4	− 1.3	− 1.5
800 F.	− 0.6	− 0.9	− 1.1
1,000 F.	− 0.2	− 0.4	− 0.7
14.7–200 psia.			
300 F.	———	———	———
400 F.	−15.6	———	−19.2
600 F.	− 7.9	− 7.9	− 9.2
800 F.	− 4.8	− 4.4	− 5.8
1,000 F.	− 2.4	− 2.1	− 3.3
14.7–400 psia.			
300 F.	———	———	———
400 F.	———	———	———
600 F.	−17.8	−17.7	−19.0
800 F.	−10.4	−10.8	−12.6
1,000 F.	− 4.8	− 4.8	− 7.2

Determining the Entropy Function

Determination of the entropy function requires the same basic data as that listed previously as being needed for the calculation of enthalpy.

First step is to calculate entropy values over the complete temperature range and at some constant pressure. Eq. (8) is used for this determination and the necessary data can usually be obtained from API 44.[1] Determination of the effect of pressure on entropy is the next calculation.

Similar to the case of the enthalpy calculations, if an equation of state predicts accurately the vapor volumetric behavior of the substance under consideration, the analytical procedure can be used to determine the vapor-phase entropy data.

If the Benedict-Webb-Rubin equation of state[4] is applicable, this form of the equation can be used:

$$S = S^{\circ} - R \ln (dRT) - [B_o R + (2C_o/T^3)]d - 0.5bRd^2 + (2a\delta^2/T^3)\left[\frac{1 - e^{-\delta\gamma d}}{\gamma\delta^2} - \frac{e^{-\delta\gamma d}}{2}\right] \quad (15)$$

can be used to calculate the effect of pressure on entropy under isothermal conditions. The value of the term S° is usually available in API 44. Assuming the equation of state can be used to determine the entropy values of the saturated vapor, the calculation for the vapor phase can be completed.

The determination of the saturated liquid-phase entropies involves the use of Eq. (10) and the relationship:

$$S_{sat.\ vapor} - S_v = S_{sat.\ liquid} \quad (16)$$

Final results of the calculations can be smoothed on a large-scale entropy vs. temperature plot. Also, any additional data beyond the absolute minimum necessary for the calculations offer opportunities to check the results.

Smooth the Data, Check Consistency

The enthalpy and entropy data can be smoothed finally on a large-scale enthalpy vs. entropy plot and the results checked for internal consistency. One procedure to check the consistency of the data is through the relationship:

$$dH = TdS + VdS \quad (17)$$

which is a statement of the first and second laws of thermodynamics.

If the value of the entropy is set at a constant, Eq. (17) reduces to:

$$dH = VdP \quad (18)$$

Multiplying the right-hand side by P/P and integrating results in this equation:

$$H_2 - H_1 = \int_{P_1}^{P_2} PV\, d(\ln P) \quad (19)$$

The right-hand side of Eq. (19) may be evaluated by graphical integration and the results compared with the enthalpy differences obtained in the calculation of the thermodynamic properties. Eq. (17) may be used in other ways. The enthalpy or pressure may be treated as constants, but the over-all procedures are basically similar.

While the analytical method for the determination of thermodynamic properties is preferred over the graphical methods, the use of the former, for all prac-

tical purposes, requires a digital computer. For this reason, a graphical method is frequently used.

Graphical Methods Require Same Basic Data

A graphical procedure requires the same basic data as the analytical solution and, in general, the calculations follow the same course.

The only differences in the methods are in the evaluation of the effect of pressure and entropy in the vapor region under isothermal conditions.

Considering enthalpy first, Eq. (6) is used to evaluate the effect of pressure. However, as we pointed out previously, either residual volumes or compressibility factors are usually used in the graphical procedure. The reason for this is that the term

$$(\partial V/\partial T)_P$$

is very difficult to evaluate accurately. If residual volumes are used, Eq. (16) becomes:

$$\left(\frac{\partial H}{\partial P}\right)_T = -\left[\alpha - T\left(\frac{\partial \alpha}{\partial T}\right)_P\right] \qquad (20)$$

Both terms of the right-hand side of Eq. (20) can be evaluated graphically with a good degree of accuracy. Three plots are needed for the solution of this equation. First is a plot of α vs. pressure with temperature parameters. This plot may be used to get

$$\int_0^P \alpha\, dP$$

Second, a plot of α vs. temperature with pressure parameters is required and third, a plot of the partial derivative of α with respect to temperature at constant pressure vs. pressure with temperature parameters.

From the third plot, we can evaluate:

$$T(\partial\alpha/\partial T)_P$$

By summing terms, we get the effect of pressure on enthalpy. And by the procedures outlined above, it's possible to determine enthalpy values for the superheated and saturated vapors.

To determine the effect of pressure on entropy in the vapor phase, Eq. (9) is used. If residual volumes are used, Eq. (9) becomes:

$$\left(\frac{\partial S}{\partial P}\right)_T = -R \ln (P_2/P_1) + \left(\frac{\partial \alpha}{\partial T}\right)_P \qquad (21)$$

The first term of the right-hand side of Eq. (21) can be evaluated analytically; and the second graphically by the procedure used in the enthalpy calculations. By these calculations it's possible to obtain entropy values for the saturated and superheated vapors.

Procedures for smoothing the final results and for checking their internal consistency are exactly the same as those outlined previously. The graphical solution using the equation of state

$$PV = zRT$$

is fundamentally the same as the method using residual volumes, so it will not be reviewed here.

Generalized Methods Replace Data Voids

For a great many substances the necessary volumetric and thermal data are not available, so the determination of derived thermodynamic properties by a rigorous method is impossible.

Since this is the case, generalized methods based on the principle of corresponding states have been developed. The most recent generalized correlations are those by Lyderson, Greenkorn and Hougen[17] and by Hobson and Weber.[18] The former is the only work which considers conditions other than the saturated ones.

Basically, the recent generalized methods make use of the equation of state:

$$PV = zRT \qquad (22)$$

and the fact that:

$$z = f(z_c, P_R, T_R) \qquad (23)$$

Considering the vapor state, the effect of pressure on enthalpy may be evaluated by Eq. (9). Differentiating Eq. (22) for change in volume with respect to change in temperature at constant pressure gives:

$$\left(\frac{\partial V}{\partial T}\right)_P = \frac{zR}{P} + \frac{RT}{P}\left(\frac{\partial z}{\partial T}\right)_P \qquad (24)$$

If we combine Eq. (24) with the expression for V obtained from Eq. (22) and substitute into Eq. (6), we can develop the following expression:

$$\left(\frac{\partial H}{\partial P}\right)_T = -\frac{RT^2}{P}\left(\frac{\partial z}{\partial T}\right)_P \qquad (25)$$

Rewriting Eq. (25) in terms of reduced properties:

$$(1/T_c)(dH)_T = -\frac{RT_R^2}{P_R}\left(\frac{dz}{dT}\right)_P dP \qquad (26)$$

Enthalpies from Different Data Sources

Average values reported, in the indicated pressure range, as Btu./lb. Superscripts indicate sources.

Ethylene, for z_c = 0.269			
1–4 psia.	H^{19}	H^{17}	H^{14}
− 20 F.	− 3.6	− 3.7	− 4.2
100 F.	− 2.0	− 1.6	− 2.1
220 F.	− 1.4	− 1.1	− 1.5
500 F.	− 0.6	− 0.4	− 0.8
1–20 psia.			
− 20 F.	———	———	———
100 F.	−13.4	−12.5	−13.7
220 F.	− 8.5	− 6.7	− 9.2
500 F.	− 4.1	− 2.7	− 3.0
1–100 psia.			
− 20 F.	———	———	———
100 F.	−110.1	−99.0	−116.0
220 F.	−50.7	−45.9	−51.2
500 F.	−20.9	−18.7	−22.6
Water, for z_c = 0.23			
50–200 psia.	H^{18}	H^{17}	H^{14}
400 F.	−24.8	−22.4	−22.8
500 F.	−15.0	−17.1	−14.5
700 F.	− 7.8	− 7.6	− 7.5
1,000 F.	− 4.1	− 4.2	− 2.2
50–600 psia.			
400 F.	———	———	———
500 F.	−68.2	−85.5	−106.9
700 F.	−30.2	−29.8	−37.7
1,000 F.	−15.4	−15.4	−10.1
50–1,000 psia.			
400 F.	———	———	———
500 F.	———	———	———
700 F.	−56.1	−53.1	−49.8
1,000 F.	−27.0	−27.5	−25.5

where the derivative holding pressure constant is the same as saying that reduced pressure is held constant.

Reversing the limits of the left-hand side of Eq. (26), the minus sign is eliminated and if the lower limit is selected as zero pressure, integration of Eq. (26) at constant temperature gives:

$$\frac{H - H^*}{T_c} = RT_R^2 \int^{P} \left(\frac{\partial z}{\partial T}\right)_P \frac{dP}{P_R} \qquad (27)$$

If only one value of z_c is considered, then $(H^* - H)/T_c$ may be plotted vs. P_R with parameters of T_R. This plot permits evaluation of the effect of pressure on enthalpy under isothermal conditions for all substances whose critical compressibility factor is the same as that selected. This procedure can be repeated for a number of different z_c values and a series of plots obtained. Lyderson, Greenkorn and Hougen[17] selected z_c values of 0.29, 0.27, 0.25 and 0.23.

Generalized relationships for entropy change are developed by following a similar line of reasoning.

However, since the isothermal entropy change with pressure is not zero for an ideal gas the representation of the entropy correction term differs from that of the enthalpy term. The usual method of reporting the generalized entropy correction term is to plot the difference of entropy of the ideal gas and the real gas at the same temperature and pressure vs. the reduced pressure with parameters of reduced temperature.

Through the use of tabulated values of $(H^* - H)/T_c$ and $(S_p^* - S_p)$ expressed as functions of z_c, P_R and T_R, it's possible to determine the derived thermodynamic properties for the superheated- and saturated-vapor states. Determination of enthalpy and, in turn, entropy of vaporization from reduced properties and the slope of the vapor pressure-temperature curve is dealt with in another article.[18]

With these additional data, it's possible to obtain the saturated-liquid enthalpy and entropy values and the complete thermodynamic network.

How Rigorous and Generalized Compare

It's of great interest to know the degree of accuracy that we can expect from using generalized charts. To illustrate this point the tables show comparisons among results obtained from thermodynamic data published in the literature, results obtained using the generalized data of Lyderson, Greenkorn and Hougen and results obtained from the generalized plot of Hougen and Watson.[14] Only the enthalpy function has been considered in our comparisons.

From the data in the tables, we can conclude that under the most extreme conditions the new generalized data of Lyderson, Greenkorn and Hougen[17] are more accurate than the generalized plot of Hougen and Watson,[14] which has been in use for a number of years. Under conditions which depart only to a limited extent from ideality, the two generalized methods are of about equal accuracy. The advantage of the new generalized tables is due to the inclusion of an additional correlating parameter, z_c, and the fact that more data were used in this compilation.

What Data Are in the Literature

While the thermodynamic properties of many compounds are not available, it's worthwhile to report the substances for which the derived properties have been calculated.

Enthalpy and entropy data are available for these hydrocarbons: methane,[18] ethane,[3] propane,[9, 22] *n*-butane,[25, 26] *n*-pentane[6] and *n*-heptane[33] in the straight-chain saturated-paraffin series; isobutane[26] in the branched-chain saturated-paraffin series; ethylene,[20] propylene[7] and 1-butene[25] in the olefin series; 1,3-butadiene[19] in the diolefin series; and benzene[23] in the aromatic series.

Also thermodynamic data are available for a number of nonhydrocarbons which are of interest to those engaged in petroleum and petrochemical processing. Data are available on: sulfur,[37] sulfur dioxide[38] and hydrogen sulfide.[36] Also, ammonia,[5] methanol,[21] ethanol,[27] ethylene oxide,[21] acetaldehyde[6] and carbon disulfide.[28] Data on the combustion gases are also available: nitrogen,[6] oxygen,[30] air,[10, 15, 28] water,[35] carbon dioxide[24, 28, 34] and carbon monoxide.[11]

While this is not intended as a complete review of the thermodynamic data in the literature, it does include most compounds that are of interest.

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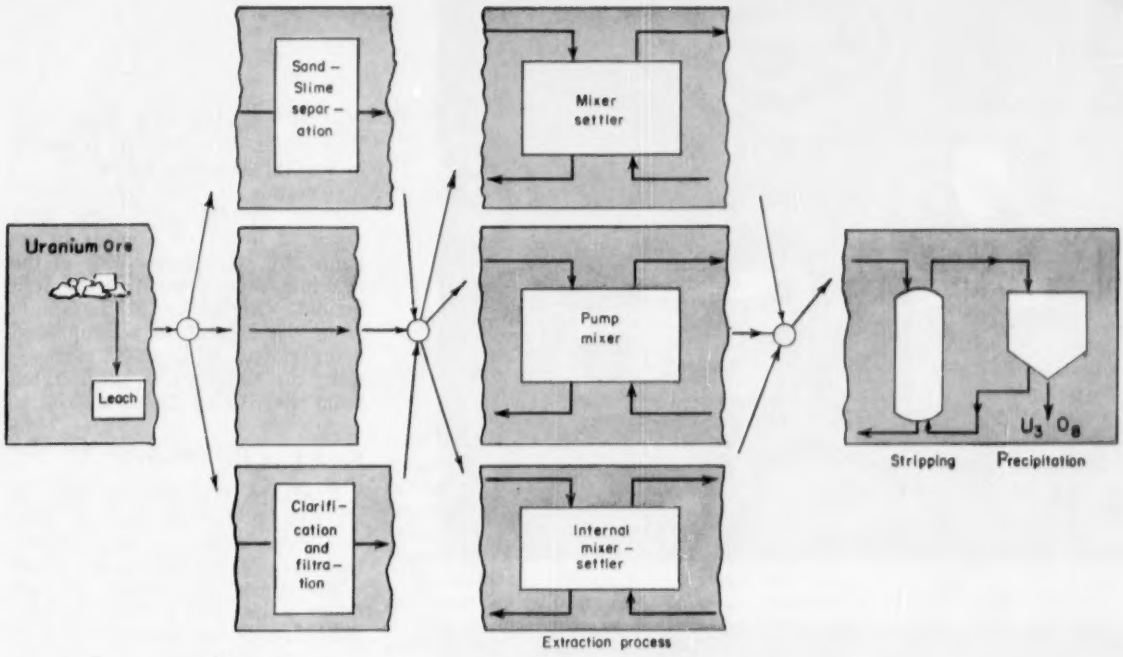


COSTS ON NEW PROCESSES FOR . . .

Solvent Extraction of Uranium

Here is new operational and cost information on solvent extraction for hydrometallurgical operations. Data can be applied to other systems.

K. GLENN SHAW and RAY S. LONG, Dow Chemical Co., Pittsburg, Calif.*

IN RECENT years, liquid-liquid extraction has become an important operation in the uranium industry. It is now being applied to recovery of uranium from clarified leach liquors at a number of mills on the Colorado Plateau[1] and in the Florida phosphate fields.[2]

With the increasing importance of hydrometallurgical operations in uranium recovery, the U. S. Atomic Energy Commssion has sponsored investigations in the technology of solvent extraction of slurries. These investigations carried out at the Bureau of Mines and Dow Chemical Co. have been directed toward the extraction of uranium from leach slurries containing up to 60% solids.

Why Use Solvent Extraction?

Uranium ores now being mined contain 0.3% or less U_3O_8. Physical upgrading methods to date have been largely unsuccessful. These ores must therefore be processed using hydrometallurgical techniques.

Processing starts with the uranium being solubilized by use of sulfuric acid or sodium carbonate leaching. Since a number of metallic impurities such as iron, aluminum and vanadium are placed into solution along with the uranium, selective recovery processes are necessary to win the uranium from the impurities. Adsorption of uranium on an anion exchange resin is the most common commercial procedure used for accomplishing this at present.

There are certain advantages to be obtained from the use of a solvent extraction recovery operation that are as follows:

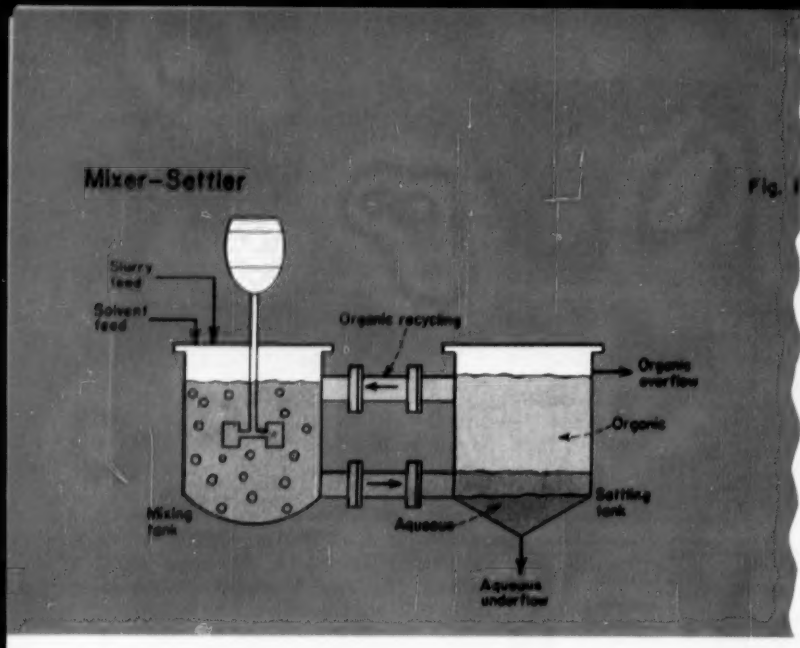
- True countercurrent operation.
- Low costs of solvents.
- Ease of "tailor making" solvent for particular metallurgical problems.
- No dilution of feed liquors.

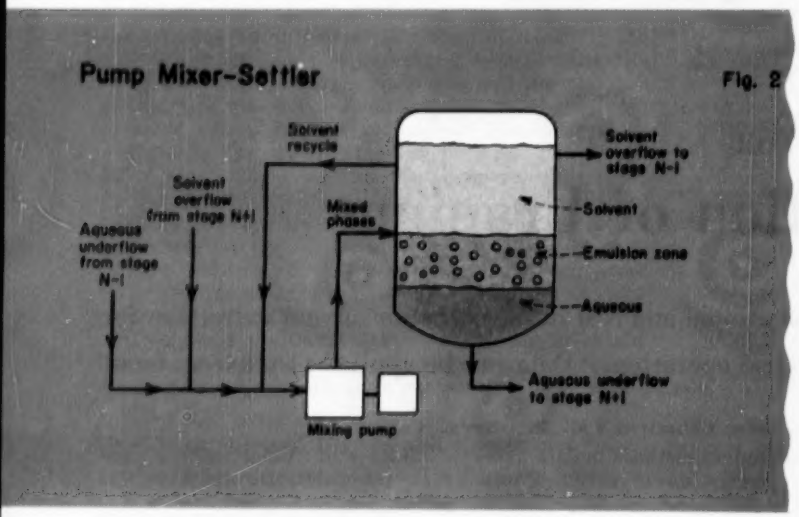
Solvent extraction procedures for uranium recovery were developed jointly by a number of AEC contractors including National Lead Co.,[3] Oak Ridge National Laboratory,[4] Bureau of Mines,[5] Dow Chemical Co.[6] and others.

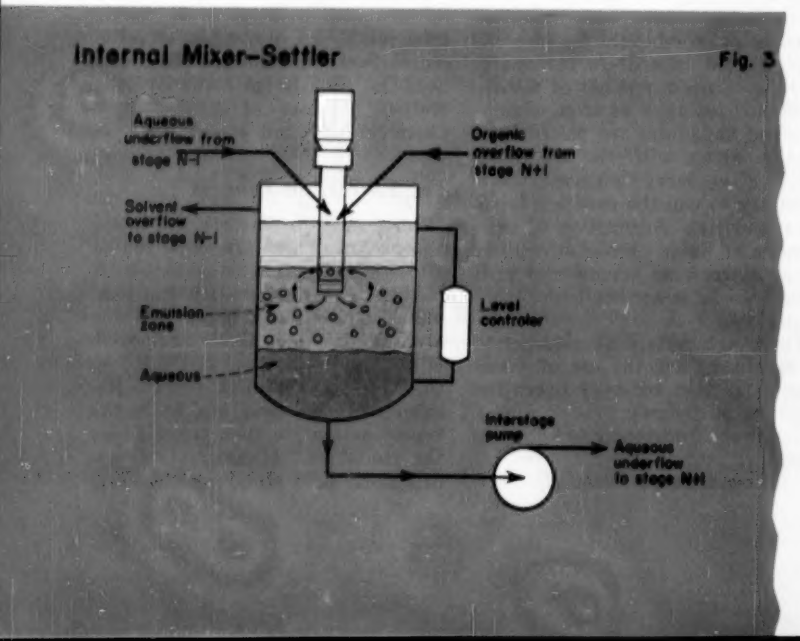
The Extraction Process

Solvents now in use are alkyl phosphates. These are employed as 3 to 10% solutions in kerosene. A solvent is contacted with the uranium-bearing leach liquor and the uranium is selectively removed. (Chemical reaction: $2RPO_4H_2 + UO_2^{++} \rightarrow (RPO_4H)_2UO_2 + 2H^+$.) Recovery of the uranium from the loaded solvent is then achieved by the use of sodium carbonate or hydrochloric acid stripping. The sol-

* Meet your authors on pp. 333 and 331.







vent is recycled with little loss. This series of operations is shown in the introductory figure.

Generally, a four-stage countercurrent system employing feed ratios of 5-to-1 of aqueous to organic will extract over 99% of the uranium value present in the feed liquors. Stripping of uranium from the solvent is accomplished using strong HCl. After evaporation, the uranium is precipitated from the HCl by use of a base.

Feed Can Be a Slurry

Feeds to this process may be slurries or clarified liquors. Slurries encountered in most hydrometallurgical operations are either dilute slimes (5% solids) or very dense pulps (40 to 60% solids). Dense pulps are obtained directly from the leach tanks. Feeding the thick undiluted material directly to the solvent extraction section, removing the uranium, and then discarding the slurry would be the simplest possible process. This avoids the clarification and filtration steps that are involved in preparing a clear liquor.

As an alternate route, the thick slurry may be diluted, the sands separated and the resulting slime slurry contacted with the extractant. Classification removes 60 to 80% of the total solids as course sands leaving a liquor containing the uranium and only 5 to 8% solids. This type of process avoids clarification or thickening but classification is still required.

Here Are the Principles

Several types of extraction equipment have been used to process a variety of slurry feeds but the principles of contacting and settling remain the same. A number of stages make up the extraction system. Each stage consists of a mixing device and a settling chamber. Intimate contact of the two immiscible phases is forced by the mixing device, permitting mass transfer of the solute, in this case uranium, from the slurry phase to the solvent.

In order to prevent emulsification of the two phases, it is mandatory to maintain the organic phase continuous while mixing; i.e., disperse the droplets of slurry within the organic phase. This condition can be maintained, even

though the slurry feed rate exceeds that of the solvent, by returning the bulk of the contacted solvent from the settler to the mixer.

Gravity separation of the two phases follows the mixing step. In the settler is a small coalescence zone, located at the interface between the larger organic and aqueous calming zones. Settling in the calming zone permits entrained particles in both phases to flow towards the interface and coalesce.

Now for the Equipment

Several modifications of the conventional mixer-settler can be used to effect uranium recovery from the slurries. Presently in common use are the conventional mixer-settler with solvent recycle; the pump-mixer; and the internal mixer-settler. These units differ only in the mixing device and in the manner of controlling solvent recycle rates. All employ a settling tank to contain the coalescence zone and the solvent and aqueous calming zones.

Mixer-Settler — "Old reliable" of liquid-liquid extraction processes is the mixer-settler. This unit is shown in Fig. 1. A baffled mixing tank with a turbine agitator is used to contact the solvent and the slurry feed streams. The mixed phases pass to the settler through the lower transfer line. Recycle solvent returns to the mixer through the upper transfer line.

Mixing intensity and organic recycle rate are controlled by varying the degree of agitation and the location of the paddle within the tank. It was found that the most satisfactory operation was obtained with a turbine of ⅓ tank diameter located halfway between the two transfer lines. Tip speeds of 300 fpm. or more for a 6-in. impeller in an 18-in. diam. tank gave almost 100% stage efficiency.

A solvent to aqueous mixing ratio of 4-to-1 is satisfactory for operation with clarified liquors. With slimes and dense pulp feeds, the mixing ratios are increased to 8-to-1 and 10-to-1, respectively. This is most easily done by maintaining the paddle speed and lowering the impeller toward the lower transfer line.

Acting as a quiescent zone for the contacted phases is the settler. In order to minimize entrainment of solvent in the aqueous or slurry phase, the interface is located below the lower transfer line. Most of the solvent is recycled to the mixer, and a quantity equal to the solvent feed stream overflows a weir at the top of the settling tank and is pumped to the next stage. By cascading the mixer-settler units, gravity flow through an external leg may be used for interstage transfer of the aqueous stream.

At present, mixer-settlers are used in the uranium industry because of their low installment cost, ease of maintenance, ease of scale-up, operational simplicity and the relatively small number of stages required.

Operational efficiency of the mixer-settler is best with clarified liquors and slimes. Considerable difficulty is experienced in handling the dense pulps of 60% solids because of rapid settling of the slurry in the transfer lines. There is also some difficulty in maintaining the high solvent recycle ratios necessary to prevent emulsions.

Pump-Mixer—Shown in Fig. 2 is the pump-mixer system in which a pump is utilized to contact the phases and to force the mixed phases through the transfer lines at high velocity. This system overcomes some of the difficulties found with the mixer-settler when handling heavy slurries.

Contacting of the phases takes place within the pump. Aqueous and solvent phases from the adjacent stages are combined with recycle solvent in the suction line.

For these studies pumps were used that had a 4-in. open impeller and operated at 1800 RPM. With this violent agitation only a few seconds residence time is required for 100% stage efficiency. Then the mixed phases are pumped to a distribution system within the settler at a point above the interface.

Disengaging of the mixed phases and the settling of entrained particles from the solvent and slurry phases is identical with the mixer-settler.

Solvent to aqueous mixing ratios for clarified liquors, slimes and heavy slurries are the same as used in the mixer-settler system. Good control of the mixing ratio is obtained by throttling the recycle solvent feed line. No difficulty was experienced with the formation of emulsions when handling slurries, but the entrainment of solvent in the heavy slurries was prohibitively high.

Pump-mixer systems are more expensive than mixer-settlers, especially for large units which require the recycle of large volumes of solvent. Its principal advantage is utilizing the mixing pump for interstage transfer eliminating the need for cascading large tanks.

Internal Mixer-Settler—By placing the agitator in the organic calming zone of the settler, a third variation of the mixer-settler has been developed by the Bureau of Mines.[6] This unit is shown in Fig. 3.

To prevent bulk turbulence within the tank, the impeller is shrouded. Top and bottom of the shroud are open in order to permit free recycle of the solvent through the impeller. Contact time within the mixer is short, but even with heavy slurries containing 60% solids both the solvent and slurry phases are recycled through the mixer many times before leaving the tubulence zone.

Control of the recycle flow rate of solvent through the mixer regulates the quantity of slimes and heavy slurries which can be handled by the mixer. Minimum mixing ratios for clarified liquors, slimes and heavy slurries are here also 4-to-1, 8-to-1 and 10-to-1, respectively.

Located well below the turbulent zone surrounding the impeller is the interface. This distance below varies between 2 ft. for the small unit processing 50 gpm. of slurry to 10 ft. for the large units processing 600 gpm. There is a solvent calming zone above the shroud to settle slurry entrainment from the solvent flowing to the next stage.

Extraction stages are usually cascaded, with the solvent being transferred by gravity and the aqueous or slurry phases being pumped. Aqueous and slurry flow is automaticlly controlled by an interface controller. Modifications of this contactor are being used by Vitro Uranium Co. and by Kerr McGee Co.[7, 8] for uranium extraction from clarified liquors.

This type of contactor has the lowest mixer cost and the lowest power requirements. However, the settler tank must be somewhat larger than the conventional mixer-settler to accommodate the mixer and its turbulent zone.

Stage efficiencies are slightly lower but are not troublesome when processing heavy clarified liquors or slimes because of the continuous recycle of both phases through the mixer. Low stage efficiency is experienced when processing heavy pulps, but this can be partially overcome by further study of mixing variables.

Of all the equipment developed and tested, this contactor gave the lowest entrainment of solvent in the slime or heavy slurry streams. This is an important advantage.

Pulse Columns—Pulse columns have enjoyed considerable success in the atomic energy program even in the processing of aqueous feeds containing small concentrations of solids. However, attempts to contact slimes and slurries with a solvent in pulse columns have all resulted in emulsions. This column cannot maintain the high ratios of organic to aqueous phase necessary to prevent emulsions.

Runs made with clarified liquor, however, have been successful and no emulsions were observed. Arnold[9] has recently disclosed the use of feeds containing several per cent solids.

Centrifugal Contactors — Centrifugal contactors have been used successfully to recover uranium from acid leach liquors by contact with kerosene-amine type solvents.[10] No attempts have been made to process slurries in these units.

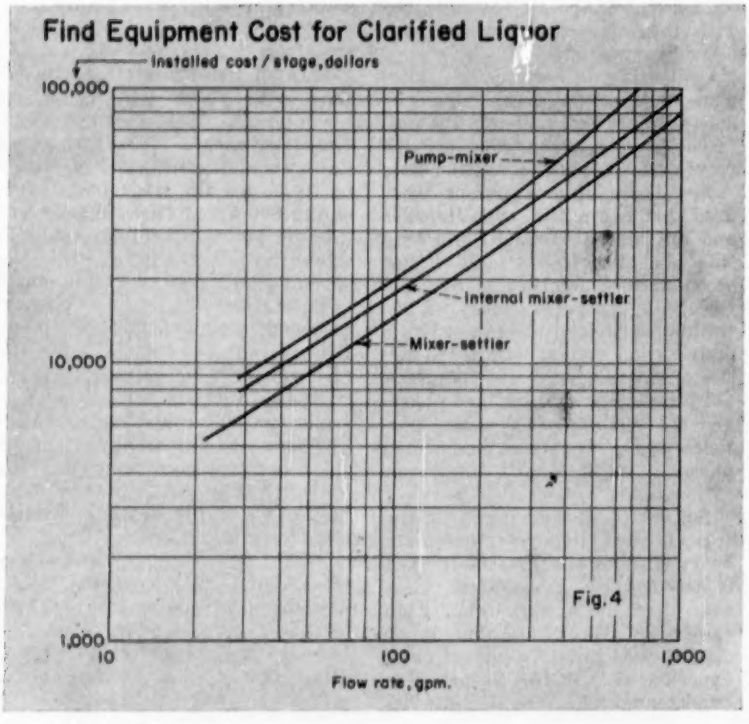
A centrifugal multistage extractor is analogous to a perforated plate tower wrapped around a shaft and made to rotate utilizing centrifugal force to give controlled intimate mixing and phase separation of liquid-liquid systems.

Production size centrifugal extractors have been applied to the solvent extraction of uranium from filtered liquors.[12] An example is the Texas Zinc installation now underway at Mexican Hat, Utah.

With clarified liquors the unit has the advantage of low entrainment, less floor space and low power cost.

Here Are Operating Conditions

	Clarified Liquors	Slimes 5% Solids	Slurries 50-60% Solids
Mixer-Settler			
Aqueous mixing time	1 min.	1 min.	
O/A mixing ratio	4/1	8/1	
Settling area	1.6 gpm./sq. ft.	0.6 gpm./sq. ft.	
Impeller tip velocity	300 fpm.	300 fpm.	
Pump-Mixer			
O/A mixing ratio	4/1	8/1	10/1
Pumping head	20 ft.	20 ft.	20 ft.
Settler area	1.4 gpm./sq. ft.	0.6 gpm./sq. ft.	0.3 gpm./sq. ft.
Internal Mixer-Settler			
O/A mixing ratio	4/1	8/1	10/1
Impeller tip velocity	570 fpm.	570 fpm.	570 fpm.
Settler area	1.4 gpm./sq. ft.	0.6 gpm./sq. ft.	0.3 gpm./sq. ft.



Performance Data Are Known

Clear Liquor—Performance of mixer-settlers, internal mixer and other types of equipment has been thoroughly tested on clear Colorado Plateau liquors. Extraction of uranium exceeding 99% can be easily obtained using four countercurrent stages with aqueous to solvent ratios of 5-to-1 with 0.1 normal DDPH (dodecyl phosphoric acid). Stage efficiencies of 80 to 90% have been obtained with these types of equipment.

Settling area is the main design factor controlling entrainment losses. If 1.6 gpm./sq. ft. of settler throughput is used in the settler, entrainment of less than 0.01% of solvent is realized with the organic phase continuous. With the aqueous phase continuous, entrainments of about 0.05% have been reported.

5% *Slurry*—With 5% slurries at throughputs of 1 gpm./sq. ft., entrainment of the order of 1 gal./ton of original ore fed have resulted using either internal mixer-settlers or conventional mixer-settlers. Uranium recovery is not

impaired by the presence of solids. At flow rates of 1.5 gpm./sq. ft. or above, entrainments greater than 2 gal./ton resulted.

A study of the surface chemistry of this system has been made in an effort to find methods for lowering the entrainment. Lignin sulfonates added in the amount of 1 to 5 lb./ton of ore feed have been found effective in lowering entrainment. Operation with dilute slurries appears to be economically competitive with clear liquor extraction.

40 *to* 60% *Slurry*—Internal mixer-settlers are the only type of contactors that have been tested extensively on heavy slurries. In general, entrainment losses are directly proportional to the solids density of the feed. With the heavy slurries containing 60% solids entrainments of 10 to 20 gal./ton have been obtained with two stages of contacting to yield 98% uranium recovery with a slurry to solvent flow ratio of 1-to-1.

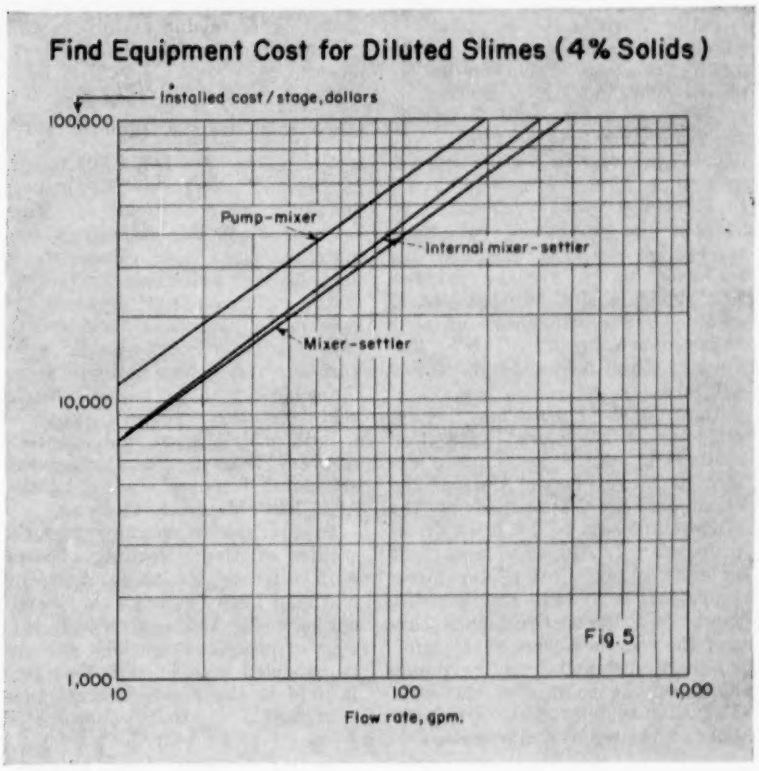
Entrainment increases with an increasing number of stages. By use of the previously mentioned additives and by diluting the raffinite four-fold with water after extraction, entrainment has been reduced in laboratory contactors to about 4 or 5 gal./ton. A study of the many variables affecting entrainment is found in the work of J. B. Byrnes.[38]

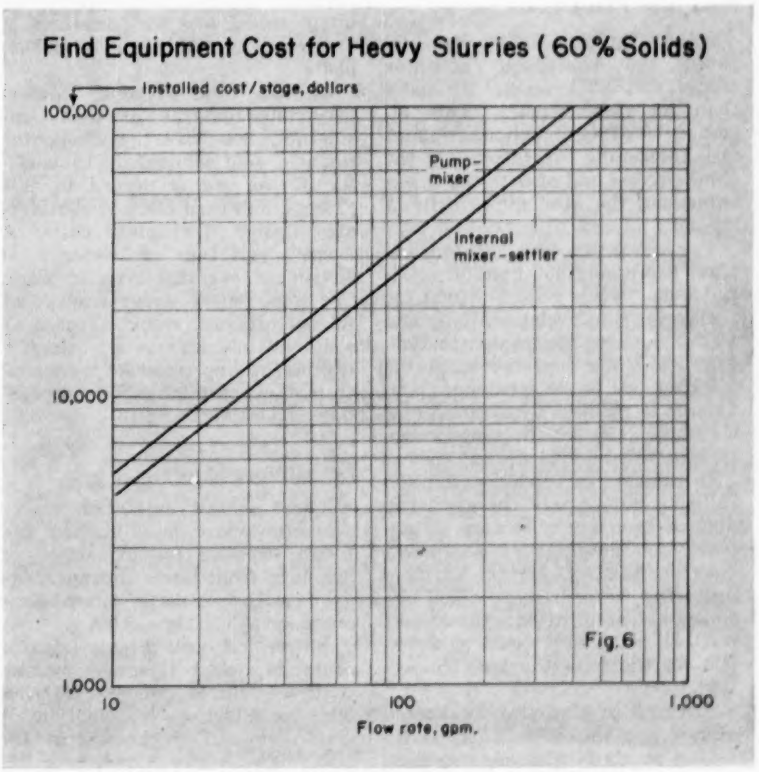
Equipment Costs Are Important

Solvent extraction equipment costs will vary widely according to the system being used and the materials of construction employed. Costs for equipment typical to those found in the uranium industry are shown in Fig. 4, 5 and 6. These curves represent the installed cost of a single stage for the three types of contactors as a function of the clarified-liquor or slurry flow rates. The following items are included:

- Process equipment: tanks, pumps and agitators.
- Foundations and installation.
- Interstage piping.
- Electrical services and instruments.

In the accompanying table are shown the design criteria used in calculating the data for the cost figures. Process equipment with ⅛-in. rubber-lining and process piping with Saran or rubber lining are represented by the solid curves.





In order to apply the same figures to steel or stainless steel equipment, the costs should be multiplied by 0.6 and 1.2, respectively.

Costs of pumps and agitators are from Aries and Newton.[9] Piping and installation were estimated using the diameter-inch method.[17] Installation of tanks was taken at 32% of the purchased cost. Contractor labor was assumed for installation at an average rate of $2.50/hr. plus 65% overhead. Also included are contingencies of 15% and contractor profit of 10%. Engineering and field supervision are not included.

Data in the curves may be applied to other solvent extraction systems if only a minimum of design data are known. Half of the stage cost is represented by the settler tank and is scaled in direct proportion to the coalescent rate in gpm./sq. ft. Cost of the mixer represents 7 to 15% and is scaled from the aqueous residence time and the recycle solvent rate. Interstage piping and transfer pumps make up the balance of the costs. For this system, these are based only on the aqueous flow rate.

Next, the Plant Costs

From Figs. 4, 5 and 6, it is apparent that equipment costs for slimes and 60% solids are more than for clear liquors. This increase is offset by elimination of the thickening operation in the slime process and of both the thickening and the sand-slimes split in the 60% slurry process.

For example, a 1,000 ton/day plant processing 350 gpm. of clarified liquor would cost $700,000 for thickening and clarification and $600,000 for solvent extraction. For 5% slime feed operation the leaching cost is the same, but clarification is replaced by desanding at a cost of $170,000. Solvent extraction cost is now $1,100,000.

In the case of solvent extraction utilizing 60% solids, the capital is difficult to estimate because a completely successful unit has never been operated. Using the existing operating information which includes entrainment of 4 to 20 gal./ton, the plant cost would be $900,000 for the solvent extraction section.

Savings in capital between the slimes and the 60% slurry processing plants is offset by increased operating costs due mainly to entrainment of organic in the slurry phases.

Here Are Other Applications

A number of other applications of solvent extraction to hydrometallurgical operations are also being studied. For example, vanadium[18] is now being recovered by use of alkyl phosphate extraction of the raffinates from uranium recovery. Extraction is done by use of a 0.4 molar alkyl phosphate in kerosene and is then stripped from the solvent with 1.0 molar sulfuric acid.

Both molybdenum and uranium recovery from lignites by solvent extraction is being studied by the AEC Raw Materials Division.

In addition to the slurry work, studies of direct leaching of ores with solvents are being made by National Lead Co. and Dow Chemical Co. under AEC contracts. In this type of process, essentially dry ore is contacted with solvent. No water is used in the process except that contained in the concentrated acids.

In the National Lead process,[14] the ore is pugged with sulfuric and nitric acids, and the uranium is extracted by use of tributylphosphate.

In the Dow process,[10, 16] alkyl phosphates in hexane are used. Considerably less than the amount of sulfuric acid equivalent to basicity of the ore is needed in this process, and thus there is considerable saving in chemical costs. A moving belt type of contactor is envisioned for this type of work. Ore would move under a spray of solvent. Hexane would be used as a diluent and also as a wash. Entrained hexane could be recovered from the ore tailings by evaporation and condensation.

Let's Summarize

Three solvent extraction slurry contactors have been studied and found effective for extraction of uranium from leach liquors. They are: mixer-settler, pump-mixer and internal mixer-settler.

Extraction costs are lowest for contacting clear liquors compared with 5% slimes or 60% slurries. This is offset by elimination of classifiers and thickeners in the latter cases.

Operating costs are dependent on solvent loss. For the heavy slurry, high entrainment losses must be reduced through further work before it can compete with dilute slurries or clear liquors. Most of the slurry work has been done with monoalkyl phosphates. Amines are absorbed on silica and thus cannot be used with slurries.

Solvent extraction applications in hydrometallury are increasing and treatment of slurries should play an important role in metals recovery in the future.

ACKNOWLEDGMENT

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General

"Binary Distillation," A. J. Teller, *Chem. Eng.*, Sept. 1954, pp. 168-188.
Fundamentals; miscible and immiscible systems; ideal and nonideal systems; equilibrium at elevated pressures; predicting and smoothing nonideal data; method for predicting the number of trays or transfer units for any condition, batch or continuous; minimum trays; Smoker's method; McCabe-Thiele method; Gilliland correction; Ponchon-Savarit method; calculation based on the Rayleigh equation; continuous batch fractionation calculations, constant distillate composition; differential distillation; methods for estimating tower height and diameter; tray efficiency; cost data; pressure drop; flooding velocities; liquid vapor distribution. Excellent coverage, clear and understandable.

"The Rosette," A. J. Teller, *Chem. Eng. Progress*, Feb. 1954, pp. 65-71.
Introduction to the design theory behind the "Tellerette" packing; HTU vs. liquid rate; transfer efficiencies; pressure drop vs. liquid rate compared with other types of packing; data showing the effect of nonwetting wall liners on column performance with "rosettes" and with other packings.

"Simplify Batch Distillation Calculations," Chao Kwang Chu, *Chem. Eng.*, Jan. 1954, p. 165.
A method for use in preliminary design calculations; a modification of the Brown and Souder's absorption factor method; results approximate more rigorous methods with much less work.

"Is Packed Height a Variable in Flooding?," Newton, W., T. Metcalfe and J. Mason, *Pet. Refiner*, Oct. 1953, pp. 125-128.
Experimental data presented to correlate flooding with packed height; the procedure, equipment, and results are presented and discussed.

"A Direct Nomographic Method for Solving Flash Equilibrium Equations," P. M. Reilly, *Pet. Refiner*, March 1953, pp. 119-122.
A variation of the method given below by same author; method is shorter due to nomographic form.

"The Theory of Unsteady-State Distillation," Rose, Arthur, and R. C. Johnson, *Chem. Eng. Progress*, Jan. 1953, pp. 15-21.
Assumptions involved in derivation of plate differential equations; equations derived; analytical solutions of differential equations; numerical solution; solution by Taylor series; derivation and application of the finite difference equations.

"New Turbogrid Distillation Trays," *Pet. Refiner*, Nov. 1952, pp. 105-108.
Description; relative efficiency data; cost data; pressure drop; tower sizes; applications.

"Effect of Column Holdup and Reflux Ratio in Binary Batch Distillation," Rose, Arthur, R. C. Johnson and T. J Williams, *Chem. Eng. Progress*, Nov. 1952, pp. 549-556.
Effect of reflux ratio; effect of holdup; comparison of calculated and experimental curves; distillate composition vs. still pot composition; favorable and unfavorable factors of holdup in batch distillation.

"How Surface Tension Affects Flooding in Packed Columns," Newton, W., J. Mason, C. Summers and T. Metcalf, *Pet. Refiner*, Oct. 1952, pp. 141-143.
Experimental data; review of methods of flooding calculations; effect of surface tension.

"Applied Distillation, Parts I-IV," K. E. Coulter, *Pet. Refiner*, Aug.-Dec. 1952.
Part I, Aug. 1952, pp. 95-103.
Fundamentals; continuous distillation of binary mixture; batch distillation effect of variables on design; effect of misplaced feed plate on operability of column; procedure outlined to check column operation; continuous distillation of multicomponent mixtures.
Part II, Oct. 1952, pp. 145-150.
Bubble cap columns; packed columns; design and calculations; allowable vapor velocities, effect of pressure, effect of plate spacing, effect of surface tension, equation for calculating mass vapor velocity, effect of diameter, effect of foaming; effect of feed temperature on liquid and vapor velocities; plate spacings; startup procedure; pressure drop data for packed towers; effect of viscosity; effect of vapor velocity; bubble plate efficiencies.
Part III, Nov. 1952, pp. 156-158.
Dehydration columns and steam distillation; partially miscible systems, azeotropic distillation.
Part IV, Dec. 1952, pp. 137-138.
Column control; distillation principles in practice.

"A Direct Method for Solving Flash Equilibrium Calculations," P. M. Reilly, *Pet. Refiner*, July 1951, pp. 132-136.
Mathematical derivation of equations for simplified method of solving equilibrium flash calculations; an approximate solution is found on the first trial usually accurate within the accuracy of the data; a correction can be made to give accuracy valid for practically all cases; sample calculations worked out.

"Precise Fractional Distillation Analysis," W. J. Podbielniak, *Pet. Refiner*, April 1951, pp. 85-92.
Theoretical investigation of low-temperature fractional analysis apparatus and methods; a discussion of the theoretical considerations for analysis by low temperature fractional distillation; charts for the use of such apparatus. Alpha vs. minimum plates for constant overhead purity; relation between temperature rise and contamination.

"A System of Process Calculations for Light Hydrocarbons, Parts I-VII," A. J. Hutchinson, *Pet. Refiner*, Oct. 1950-April 1951.
Part I, Oct. 1950, pp. 83-89.
Presentation of a simplified and standardized calculation method for light hydrocarbon processing equipment. Principles presented in some detail.
Part II, Nov. 1950, pp. 117-122.
Equilibrium considerations; flash computations; heat and material balances; calculation forms presented.
Part III, Dec. 1950, pp. 97-103.
More standardized forms; absorption calculations; extraction; theoretical approach.

Part IV, Jan. 1951, pp. 145-148.
Stripping columns; design considerations; theoretical approach; calculations standardized; forms presented.
Part V, Feb. 1951, pp. 107-112.
Fractionation; calculations; design considerations; theoretical approach; standardized forms; reflux ratio; minimum trays; feed location; limitations.
Part VI, March 1951, pp. 107-114.
Design calculations for fractionation; standardized calculations and forms; minimum reflux with infinite trays; operating reflux ratio and theoretical plates.
Part VII, April 1951, pp. 119-122.
Column sizing; charts for surface tension vs. nuclear weight for n-paraffin hydrocarbons; absorber selection; still selection; fractionating column selection; heat exchanger specifications; centrifugal and reciprocating pump specifications; standard forms.

"Evaluation of Vacuum Flash Vaporization Curves From Atmospheric True Boiling Point Distillation," Okamoto, K. K., and M. Van Winkle, *Pet. Refiner,* Jan. 1950, pp. 91-96.
Refinement of the article below by same authors; charts given here avoid necessity of converting from volumetric to molar basis in going from laboratory to plant data; also, correction is made in higher pressures to allow for nonideality.

"Correlation of Equilibrium Flash and True Boiling Point Distillation Curves at Sub-Atmospheric Pressures," Okamoto, K. K., and M. Van Winkle, *Pet. Refiner,* Aug. 1949, pp. 113-120.
Experimental data correlated to demonstrate that vacuum flash curves do not often parallel atmospheric flash curves; tabular and graphical presentation of results; correlation curves given for pressures of 3,000, 1,000, 760, 400, 100, and 10 mm.Hg.

"Steam Distillation of Hydrocarbons and Chlorohydrocarbons," Melvin Nord, *Chem. Ind.,* Nov. 1946, pp. 884, 886.
A nomograph to evaluate one of the criteria of the process, showing the weight % of hydrocarbons and chlorohydrocarbons in the distillate as a function of the temperature or pressure of the steam distillation.

"Azeotropic Distillation," Ewell, R. H., J. M. Harrison and Lloyd Berg, *Ind. and Eng. Chem.,* Oct. 1944, pp. 871-875.
A summary intended to minimize the experimental work required in the selection of an entrainer to effect a desired separation by azeotropic distillation. Separation of close boiling mixtures; hydrocarbon separation.

"Ternary Liquid Equilibria," R. E. Treyball, *Ind. and Eng. Chem.,* Oct. 1944, pp. 875-881.
A method for predicting ternary liquid equilibria from binary vapor-liquid data. A modification of the graphical method of Hildebrand; effect of high solute concentrations; constant temperature data; azeotropic data; plotting of ternary data.

"Distillation Practices and Methods of Calculations," D. F. Othmer, *Chem. and Met. Eng.,* May 1942, pp. 84-92.
General review; equilibrium; diffusion; methods of calculation; equipment; processes; some flowsheets of typical applications.

"Distillation and Absorption in Packed Columns," T. Baker, *Ind. and Eng. Chem.,* Aug. 1935, p. 977.
An improvement on Chilton and Colburn's methods for graphically determining HTU from a McCabe-Thiele diagram.

"Distillation and Absorption in Packed Columns," Chilton, T. H., and A. P Colburn, *Ind. and Eng. Chem.,* March 1935, pp. 255-260.
A clear presentation of the ideas of HTU and HETP; the concepts applied to examples for distillation and absorption; calculation methods; correlation of HTU data; comparison of HETP and HTU for the same problem.

Design

"Design Packed Columns," J. K. Jacobs, *Pet. Refiner,* June 1956, pp. 187-188.
Nomograph for design of packed tower based on equations from page 40 of the second edition of Max Leva's text on "Tower Packing and Packed Tower Design," published by U. S Stoneware Company, Akron, Ohio.

"Save Money on Bubble-Cap Columns," Walsh, T. J., and P. G Lafyatis, *Chem. Eng.,* April 1956, pp. 193-196.
Method and graph for calculating liquid handling capacity for any combination of vapor rate, vapor density, liquid density. Useful in calculating capacities of existing columns and tray design for new applications.

"Optimum Bubble-Cap Tray Design, Parts I-IV," W. L. Bolles, *Pet. Processing,* Feb.-May 1956.
Part I, Feb. 1956, pp. 64-80.
Tray dynamics; slot openings; liquid height over weir; liquid throw over weir; liquid gradient; effect of annular/riser area ratio on pressure drop; bubble-cap pressure drop constant; liquid height in downcomer; entrainment; plate efficiency; comparison of several methods; excellent graphical data for design.
Part II, March 1956, pp. 82-95.
Design standards; tray types; materials of construction; downcomers; overflow weirs; bubble-cap design; bubble-cap pitch; tray dynamics; vapor distribution; effect of liquid gradient on vapor distribution; entrainment; effect of vapor load on entrainment; tray spacing; pressure drop; leakage and packing; weirs; baffles; clearances; very detailed.
Part III, April 1956, pp. 72-79.
Design technique; selection of tray type; downcomers and weirs; tray areas; bubble-cap size and arrangement; bubble-cap stepping; tray layout; tray design stepwise procedure; load variations; optimum design; layout charts.
Part IV, May 1956, pp. 109-120.
Very detailed example worked out to illustrate methods developed in Parts I-III. Entire series is an excellent design aid.

"Help in Picking the Right Tray," Raphael Katzen, *Chem. Eng.,* Nov. 1955, pp. 209-212.
Tower diameter; tray spacing; entrainment; optimum design; tray types; cost data as affected by design.

"New Approach to Tray Design," Paul Munk, *Pet. Refiner,* July 1955, pp. 104-108.
A method for developing design charts which take into account the interdependence of vapor and liquid flow. Preparation and application of charts and method explained.

"Fast Methods for Minimum Plates," R. M. Butler, *Pet. Refiner,* July 1955, pp. 109-110.
A graph to estimate the minimum number of plates required for separation of hydrocarbon mixtures at atmospheric pressures. The relation between the distillate and bottoms composition; the relation between the boiling point and relative volatility.

"Slot Openings in Bubble-Caps," Winn, F. W., and G. J. Keller, *Pet. Refiner,* July 1955, pp. 111-113.
Rapid and direct solutions in nomographic form.

"New System Simplifies Tray Layout," A. W Francis, *Chem. Eng.,* June 1955, pp. 260, 262.
A graphical method of tray layout in which no actual layout need be made until the final tray has been determined.

"New Distillation Nomographs for Easy Estimating," F. Rodriguez, *Pet. Refiner,* Feb. 1955, pp. 182-183.
Nomographs to rapidly estimate the difficulty of separating two components by fractional distillation.

Fenske equation; Trouton's rule; vapor pressure vs. temperature.

"New Plate to Plate Method," Akers, W. W., and D. E. Wade, *Pet. Refiner*, Nov. 1954, pp. 199-203.
Method permits plate to plate computations in a direct manner by combining the equilibrium and material balance relations on each plate; plate temperatures may be obtained directly. Detailed design calculations.

"Locating Optimum Feed Tray," S. R. M. Ellis, *Pet. Refiner*, Sept. 1954, pp. 307-309.
A simple rapid method is suggested for determining the number of equilibrium stages above the feed tray; the method has been found to give good results on a large number of binary and multicomponent systems.

"Recycle Process Material Balance," O. L. Culberson, *Pet. Refiner*, Aug. 1954, pp. 127-130.
Graphs provide a quick way to translate conversion, efficiency and yield relationships from a single pass to a recycle basis.

"Three New Tray Designs," *Chem. Eng.*, May 1954.
"Uniflux," V. O. Bowles, pp. 174-175.
Bubble-caps; uniflux trays; operating characteristics.
"Float-Valve," I. E. Nutter, pp. 176-177.
How float-valve trays operate.
"Flexitray," G. C. Thrift, pp. 177-178.
Design details; operating characteristics; installations.

"Sieve Trays," D. C. Lee, Jr., *Chem. Eng.*, May 1954 pp. 179-182.
Pressure drop; development of data; aeration factors; operating ranges; plate efficiencies; weep-point; design data; applications.

"Sizing Refinery Distillation Equipment," Atkins, G. T., and G. W. Wilson, *Pet. Refiner*, May 1954, pp. 144-150.
A procedure for estimating tower sizes, heat requirements, and heat exchange surface is by the use of correlations which show fractionation equipment size and capacity for various services plotted as a function of the operating pressure. Vapor capacity; steam strippers and absorbers; fractionation; relative volatility; heat transfer service; evaluation of existing fractionation facilities; tower diameter; heat input requirements.

"Designing Stripping Columns," N. H. Prater, *Pet. Refiner*, Feb. 1954, pp. 96-98.
Graphical solution for the number of theoretical trays in a stripper; steam requirements; number of stages; optimum design; fugacity; step by step analysis of design procedure.

"What Every Engineer Should Know About Packed Tower Operations," F. A. Zenz, *Chem. Eng.*, Aug. 1953, pp. 176-184.
Pressure drop curves; flooding point; pressure drop at flooding; gas continuous range; liquid continuous range; degree of wetting; effect of viscosity; a comprehensive analysis of the latest thinking in the field.

"Froth and Foam—The Bases for Tower Sizing," F. A. Zenz, *Pet. Refiner*, Jan. 1953, pp. 150-154.
Liquid gradients; allowable velocity; tray sizing; tray spacing; tower sizing; tray hydraulics; liquid foaming tendencies.

"Analytical Solution for Crowded Ends of McCabe-Thiele Diagram," R. G. Biick, *Pet. Refiner*, Aug. 1952, pp. 105-107.
The article presents a simple and analytical method for obtaining the number of plates in these crowded regions. No new theories are presented, but formulas of utility are derived and recorded for ready application.

"Calculation of Pressure Drop Through Packed Towers," Max Leva, *Chem. Processing*, Aug. 1952, pp. 160-162.
Nomographic form based on voidage; gas mass velocity; liquid mass velocity; effective packing particle diameter; gas density.

"Fractionation Calculations Made Easier and Faster," Pennington, E. N., F. H Poetmann and K. H. Hackmuth, *Pet. Refiner*, July 1952, pp. 103-107.
Simplified calculations for solution of multicomponent fractionation problems; method applicable also to location of the feed plate; development of method; example calculations.

"What Goes On Inside Bubble-Caps?," F. A. Zenz, Chem. *Eng.*, April 1952, pp. 169-172.
Slot openings; tower diameter; tray vapor capacity; liquid gradient; tray spacing; slot submergence; a method starting at the bubble-cap and working out to tower diameter.

"Pressure Drop Through Bubble Caps, Parts I-III," Huitt, J. L., and R. L Huntington, *Pet. Refiner*, June-Oct. 1951.
Part I, June 1951, pp. 131-134.
Introductory; pressure drop necessary to cause a vapor to flow through the submerged slots of a bubble cap, determined by analysis of the static and dynamic forces opposing the flow of vapor. Pressure drop due to flow reversal, liquid seal, slot opening, surface tension, change of vapor velocity.
Part II, August 1951, pp. 111-118.
Equipment and evaluation of equations; minimum slot openings for incipient vapor flow; pressure to overcome surface tension during incipient vapor flow; calculated and observed pressure drops through dry slots; liquid viscosity and pressure drop; pressure drops through various caps.
Part III, Oct. 1951, pp. 153-154.
Applications of equations derived in Parts I and II.

"Distillation Column Balance," W. D. Harbert, *Pet. Refiner*, Oct. 1950, pp. 117-122.
Overhead-bottoms split vs. the feed composition; instrumentation; operational plots; trouble shooting; theory applied that explains much that has been excused as poor plate efficiencies.

"Bubble Trays—Design and Layout, Parts I-II," J. A. Davis, *Pet. Refiner*, Aug. and Sept. 1950.
Part I, Aug. 1950, pp. 93-98.
A methodical tray calculation method, sufficient information is given to allow a person without extensive design experience to reach sound design answers on bubble tray problems. Mechanical details; foundations; thermal expansion; tray level; hold down; tower roundness; leakage; support rings; inlet and draw-off arrangements; accessibility; buffer trays.
Part II, Sept. 1950, pp. 121-130.
Tray calculations; static submergence; cap skirt height; vapor-liquid contact; liquid distribution; vapor distribution; cross flow of liquid; pressure drop; tray features; tray layout; calculation sheets; procedure; equations; slot velocity; downflow width; downflow residence time.

"Pressure Drop in Packed Tubes," Weintraub, Murray, and Max Leva, *Chem. Eng. Progress*, Oct. 1948, pp. 801-802.
A nomogram with typical problems for aid in the rapid calculation of pressure drop through packed tubes when the flow is turbulent and the packing is smooth.

"Vacuum Distillation Equipment," R. N Blaize, *Pet. Refiner*, Sept. 1948, pp. 108-109.
Selection and design; vacuum equipment used in conjunction with a topping unit to give economical operation; dry distillation; jet ejector systems as applied to vacuum distillation.

"Determination of Allowable Vapor Loads in Tray Towers," S. M. Walas, *Chem. Ind.*, Oct. 1947, pp. 684, 686.
Nomographic form.

"Alignment Chart for Calculating Allowable Vapor Velocity in Plate Towers," W. C. Frishe, *Pet. Refiner*, July 1947, pp. 110-111.

"Effect of Concentration Gradient on Plate Efficiency." Melvin Nord, *Chem. Ind.*, Jan. 1947, pp. 106-108.
Nomographic form.

"Rapid Graphical Method of Estimating Tower Diameter and Tray Spacing of Bubble-Plate Fractionators," W. L. Bolles, *Pet. Refiner*, Dec. 1946, pp. 103-110.
Alignment charts are presented for estimating tower diameter and tray spacing of bubble plate fractionators. These charts based on four standard tray designs. Design intended to insure sufficient vapor capacity to avoid excessive entrainment; liquid capacity sufficient to avoid flooding. Cost data showing the effect of variation in tower diameter and tray spacing on cost.

"Simplified Calculation of Theoretical Plates," Thomson, George, and Harold Beatty, *Ind. and Eng. Chem.*, Sept. 1942, pp. 1124-1130.
Fractionation of a binary mixture in which the concentration of one component is small. Review of different methods; derivation of equations; q. line; proper choice of α; equations for R vs. N.

"Nomographs for Minimum Reflux Ratio and Theoretical Plates for Separation of Binary Mixtures," E. H. Smoker, *Ind. and Eng. Chem.*, May 1942, pp. 509-510.

"Flooding Velocities in Packed Columns," Sherwood, T. K., G. H. Shipley and F. A. L. Holloway, *Ind. and Eng. Chem.*, July 1938, pp. 765-769.
Data are presented showing the effects of gas density and liquid viscosity on the flooding velocity in a packed column.

"Intalox Saddle Packing," U. S. Stoneware Company, *Bulletin S-29*.
Pressure drops, flooding limits; HTU values; gas pumping costs; liquid rates; tower height; gas rates.

Physical Data

"Vapor-Liquid Values Made Easy," J. F. Voorwijk, *Chem. Eng.*, May 1956, pp. 201-202.
Circular nomograph for vapor-liquid equilibrium calculations; can be used for interrelating weights, volumes, mole fractions of binary mixtures.

"Plot Vapor-Liquid Equilibrium Diagrams Faster," N. N. Buchsbaum, *Chem. Eng.*, Feb. 1956, pp. 168-170.
A useful chart which can be used to quickly construct a vapor liquid equilibrium curve without calculation; relative volatilities of some ideal mixtures.

"Short Cut to V-L Equilibria Solutions," Grosberg, J. A., and G. E Mapstone, *Pet. Refiner*, March 1955, pp. 193-196.
A method intended to reduce the trial and error calculations required to one or two at the most; use is made of Newton's method of approximation.

"Equilibrium K's by Nomograph," F. W. Winn, *Pet. Refiner*, June 1954, pp. 131-135.
Correlation of the vapor-liquid equilibria K ratios of the light hydrocarbons, narrow cut petroleum fractions and certain nonhydrocarbons are presented as a function of the temperature and pressure of the system and the composition of the liquid phase. Applicable from 40 to 800 F. at pressures up to 10,000 psi.

"A Direct Method for Predicting Vapor-Liquid Equilibrium Ratios, Parts I-II," Lenoir, J. M., and G. A. White, *Pet. Refiner*, Oct.-Dec. 1953.
Part I, Oct. 1953, pp. 121-123.
A direct solution; no trial and error; applicable to olefins and paraffins; pressures up to 10,000 psi.; convergence pressure; effect of pressure and composition on equilibrium-ratios; effect of component identity on equilibrium-ratios.
Part II, Dec. 1953, pp. 115-119.
The convergence pressures of multicomponent mixtures calculated by this method.

"The Solution of Multicomponent Phase Equilibria Problems," C. L. Wilson, *Pet. Refiner*, June 1952, pp. 131-138.
New techniques developed for simplifying calculations of bubble points, dew points and flash vaporization. A simple graphical method for estimating flash vaporization and reducing the amount of trials required in the application of more precise methods. Review of the basic mathematics and previous calculation methods; Cox vapor pressure chart; procedure for solving flash equilibria problems.

"Alignment Chart for Calculating Relative Volatility," W. C. Frishe, *Pet. Refiner*, Jan. 1950, p. 137.
Nomograph to calculate relative volatility from boiling point difference; total pressure and average boiling temperature.

"Vaporization Equilibrium Constant and Activity Coefficient Charts," Smith, K. A., and R. B. Smith, *Pet. Processing*, Dec. 1949, pp. 1355-1360.
Fugacity coefficients of gases and vapors; vaporization equilibrium constants; vapor phase activity coefficients; volatility index for paraffin hydrocarbons; liquid phase activity coefficients.

"Chart for Distillation of Binary Mixtures," J. W. Faassen, *Ind. and Eng. Chem.*, March 1944, pp. 248-252.
Chart provides a rapid means for approximating the number of theoretical plates and corresponding reflux ratios for problems in the distillation of binary mixtures.

Instrumentation and Control

"Distillation Control Problems," Bauer, R. L., and C. P. Orr, *Chem. Eng. Progress*, June 1954, pp. 312-318.
McCabe-Thiele diagrams used to determine the degree of control attainable with given distillation control systems; basic theory and principles; determining the effect of a change in some variable; operating line equations; Q line; application of method.

"Improved Control Gives Maximum Boil-up in Distillations," Leonard Steber, *Chem. Eng.*, Jan. 1954, p. 224.
A way to combine the desirable elements of pressure and temperature control of the steam flow, while allowing tower operation near the loading point, yet preventing overhead product components from flowing to the bottoms if feed composition should change.

"Control Systems for Distillation Towers," Cyrus Pyle, *Oil and Gas Jour.*, Oct. 13, 1949, pp. 97-99.
Atmospheric towers; vacuum towers; pressure towers; recording flow controllers; recording pressure controls; recording temperature controllers; recording differential pressure controller; applications; arrangement; operation.

"Fractionation Instrumentation and Control, Parts I-II," D. M. Boyd, Jr., *Pet. Refiner*, Oct.-Nov. 1948.
Part I, Oct. 1948, pp. 115-118.
Review of the general problem of selecting and applying control instruments to the principal fractionating equipment arrangements in general commercial use. Overall problems discussed; methods of pressure control applicable to various specific fractionation operations.
Part II, Nov. 1948, pp. 114-117.
Composition control and material balance control for both continuous and batch type operation. Rectification section temperature control; stripping section control; material balance control; batch fractionation column.

"Automatic Control of Fractionating Columns," V. V. St.L. Tivy, *Pet. Refiner*, Nov. 1948, pp. 123-128.
Discussion of the reasoning which should be followed in the application of automatic controllers and emphasis is laid on the necessity for close integration between plant design and automatic control engineering. A number of typical control systems are dis-

cussed culminating in the suggestion of a new method for control of precise fractionators.

"Control of Continuous Fractionation Columns," C. W. Hills, Jr., *Canadian Chem. and Process Ind.*, June 1948, pp. 536-540.
Presentation of an instrumentation system devised to control the changes in feed which alter the equilibrium composition of the material in process. Feed rate; control of column variables; withdrawal of overhead product; withdrawal of bottom product; heat supply to column; control systems.

Operation

"How to Test Fractionators, Parts I-II," Kelley, R. E., T. W. Pickel and G. W. Wilson, *Pet. Refiner*, Jan. and Feb. 1955.
Part I, Jan. 1955, pp. 110-114.
Discusses fractionator tower capacity from the viewpoint of plant test procedures that yield information as to the capacity of a given fractionation tower in a given service. Capacity and efficiency tests discussed.
Part II, Feb. 1955, pp. 159-165.
Testing and evaluating atmospheric crude distillation towers and catalytic cracking unit fractionators; operating conditions; requirements of separation; general tower design; analysis of capacity tests; operation of the tower; example of tower analysis; rate comparisons.

"Fractionation Calculations for Existing Columns," Rea, H. E., Jr., and D. N. Hanson, *Pet. Refiner*, Nov. 1952, pp. 139-143.
Feed plate location for various feeds; Thiele-Geddes method; feed quality; control component distribution; temperature specification; phase ratio gradient.

"The Technique of Vacuum Still Operation," Q. E. Benedict, *Pet. Refiner*, Jan. 1952, pp. 103-106.
Reviews all aspects of the subject; special importance given to the proper operation of vacuum stills and methods of resolving common operating problems; factors influencing operation; factors involving yields.

Evaporation

General

"Differential Evaporation of a Binary Mixture," Mapstone, G. E., and D. S. Davis, *Chem. Processing*, Sept. 1953, p. 55.
Nomographic solution of the integrated form of the Rayleigh equation.

"Evaporation," Ernest Lindsey, *Chem. Eng.*, April 1953, pp. 227-240.
Well illustrated; basic considerations; types, giving advantages and method of operation of each; entrainment separators; instruments; performance; flashing evaporators; sealing problems; feed preheating; mechanical recompression; steam jet vapor recompression; heat pumping with auxilliary fluid; temperature effects on price; cost consideration and data; multiple-effect operation; comparison of heat saving methods.

Design and Selection

"Cost Factors in Evaporator Design," Kohlins, W. D., and H. P. Englander, *Chem. Eng. Progress*, Feb. 1956, pp. 45F-48F.
Points out areas for cost reduction in evaporator design and specification; investment costs; operation costs; physical design; flowsheet and operating conditions; heat reclaimation.

"Selection and Application of Evaporation Equipment," Coston, M. M., and E. E. Lindsey, *Chem. Eng. Progress*, Feb. 1956, pp. 49F-52F.
Article attempts to show effect of physical characteristics of streams, and mechanical design on costs. Evaporator types; separators; condensers; vacuum pumps; effect of viscosity; heat sensitivity; small plants; optimum number of effects; examples considered.

Operation and Control

"Entrainment in Evaporators," Manowitz, B., R. H. Bretton, and R. V. Horrigan, *Chem. Eng. Progress*, July 1955, pp. 313-319.
Entrainment in evaporators; submerged coil systems; de-entrainment units; vapor compression stills; operation; efficiencies of three de-entrainment devices; effect of boil-up rate.

"Control of Multiple-Effect Evaporators," Camp, A. C., and L. E. Slater, *Chem. Eng.*, Sept. 1950, pp. 108-111.
General approach to basic instrumentation; auxillary instrumentation; integrated control systems; level controls; density controls.

Absorption

General

"Take This Short Cut in Computing Absorber Material Balance," Thompson, R. B., and E. D. Frigar, *Pet. Refiner*, April 1953, pp. 145-148.
A method used in calculating an absorption problem in existing equipment; example calculations.

"Efficiency Characteristics of Commercial Absorbers," E. G. Ragatz, *Pet. Refiner*, Dec. 1959, pp. 117-124.
Experimental data on 275 tests on 75 absorbers tabulated and correlated; % absorbed vs. absorption factor.

Design

"Absorption and Stripping Design, Parts I-III," R. H. Parekh, *Pet. Refiner*, June-Aug. 1955.
Part I, June 1955, pp. 123-126.
Types of design methods; graphical method; analytical method; stripper design.
Part II, July 1955, pp. 129-136.
General procedure; calculations; standard forms; graphs; effect of number of theoretical trays on oil circulation; reabsorber; equilibrium constants; temperature change due to absorption.
Part III, Aug. 1955, pp. 123-127.
Stepwise procedure outlined; absorption and stripping factors vs. efficiency; nomograph for equilibrium k's; heat exchange loads; liquid product recovery; standardized calculation forms.

"Fractionating Absorbers in the Petroleum Industry," J. C. Hannah, *Pet. Refiner*, Aug. 1949, pp. 135-140.
Design problems involved in fractionation absorbers; a shortcut method for calculating lean oil requirements; emphasis is on the natural gasoline industry; recovery vs. absorbing oil rate; heat transfer relationships around the rich oil de-ethanizer; design method.

"Hydrocarbon Absorption and Fractionation Process Design Methods," W. C. Edmister, *Pet. Eng.*, Dec. 1948, pp. 193-200.
Fluid dynamics of bubble plate columns; flow patterns; types of bubble plates; bubble plate operation; vapor and liquid flows; column flooding; pressure drop; weir crest; discharge coefficients; effective lengths for suppressed rectangular bubble tray weirs; vapor loss; liquid gradients; downflow and sealpot.

Adsorption

General

"Adsorption Techniques Are Ideal for Difficult Separations," R. E. Treybal, *Chem. Eng.*, Oct. 1952, pp. 150-152.

Comparison with absorption and distillation processes; limitations of adsorption processes; analogy between contact filtration and flash vaporization; analogy between fixed bed adsorption and gas adsorption; percolation; equilibrium; continuous fractional adsorption.

"Liquid Phase Processes Are Important," W. A. Helbig, *Chem. Eng.*, Oct. 1952, pp. 153-157.
Selection of the proper adsorbent, effect of process variables on efficiency of adsorption, and adsorbent regeneration for liquid phase systems; materials of construction; process variables; regeneration by steam, solvents or burning; chemical regeneration; contact time; temperature effects.

"Vapor Phase Processes Serve Industry Well," F. M. Browning, *Chem. Eng.*, Oct. 1952, pp. 158-161.
Fixed bed units for solvent recovery, gas purification and gas dehydration; moving bed units; solvent recovery; gas separation.

"Adsorption, Bigger Role Lies Ahead," C. L. Mantell, *Chem. Eng.*, Oct. 1952, pp. 166-168.
Development of adsorbents; adsorbents listed giving typical applications; process advances discussed.

Design

"Fixed Bed Design More Empirical Than Moving Bed," Robert Merims, *Chem. Eng.*, Oct. 1952, pp. 161-163.
Design of fixed and moving bed adsorbers.

"Adsorption Theory and Practice Are Converging," Leon Lapidus, *Chem. Eng.*, Oct. 1952, pp. 164-166.
Material balance; transport and adsorption rates; equations for design.

Drying

Equipment Selection

"Drying—Design anl Costs," Lapple, W. C., W. E. Clark and E. C. Dyrdal, *Chem. Eng.*, November 1955, pp. 177-200.
Sizing; calculations and equations; temperature level and heat demand; critical moisture content of materials; application of theory; drying equation derivation; analogy between heat and mass transfer; falling rate of period; variable drying conditions; constant temperature drying; fixed bed voidage or porosity; shape factor; installed costs; updating costs; freight costs; labor costs; direct materials costs; fixed charges; construction costs; operating costs.

"Drying Methods & Equipment" Lapple, W. C., and W. E. Clark, *Chem. Eng.*, October 1955, pp. 191-210.
Basic theory; types; principles; comparative advantages of dryers; humidity principles; constant rate and falling rate drying; selection data; special dryers and their applications.

"Steps in the Selection of Drying Equipment," S. J. Friedman, *Heating and Ventilating*, February 1951, pp. 95-110.
Rules for the proper selection of a dryer for a given service; classification by method of heat transfer; preliminary selection; initial comparison; drying tests; tabular presentation of types, applications and manufacturers; pilot plant; final dryer selection; installed costs; operating costs; specific examples worked out in detail. Excellent presentation.

Spray Drying

"Principles of Spray Drying, Parts I-II," Marshall, W. R., Jr., and Edward Seltzer, *Chem. Eng. Progress*, Oct.-Nov. 1950.
Part I, Oct. 1950, pp. 501-508.
Advantages and disadvantages; fundamentals; types, air velocity and drop size; pressure atomization; two fluid atomization; power consumption on disk atomizers; evaporation lifetime of pure liquid drops; spray gas mixing.
Part II, Nov. 1950, pp. 575-584.
Operating variables; selection of method of atomization; pressure nozzles; feed concentration; method of product removal; design and operating problems; perfromance; power requirements vs. evaporation rate; economics of spray drying; capacities.

Convection Ovens

"Production Data Sheet No. 6—Selecting Convection-Type Ovens," C. R. Sare, *Factory Management and Maintenance*, May 1955, pp. 148-152.
Two forms; one to specify performance required and the other to compare bid offerings on convection ovens.

Miscellaneous

"Desolventizing Solids With Air Dryers," *Chem. Eng.*, October 1955, pp. 130-134.
Description of problems and solution in drying solvent wet materials safely; auxiliaries; safety devices.

"Drying in Fish Meal Reduction Plants," Norman Pitt, *Fish Meal and Oil Industry*, November 1951, pp. 6, 7, 10, 11.
Batch and continuous dryers; direct and indirect fired; rotary steam dryers; some cost data; performance evaluation.

Air Pollution

General

"Atmospheric Pollution," L. C. McCabe, *Ind. and Eng. Chem.*, Nov. 1952, pp. 123A-125A.
Description and applications of curtain-type dust collector; design factors; costs.

"Easier to Control Than to Regulate," H. E. Clo, *Heating, Piping and Air Cond.*, Sept. 1952, pp. 114-116.
Particle size; definition of the problems; desirable standards; basic types of control equipment; graphical presentation of particle size ranges for various types of collection devices.

"Contaminants in Air," *Ind. and Power*, Jan. 1952, pp. 67-98.
Definition and description of types of contaminants; applicable laws regarding air pollution; city ordinances; smoke density; collector types; particle size; air leakage; electrostatic type collector; smoke reduction principles; oil burners; combustion controls; fumes and vapors.

Odor Control

"Industrial Odor Control," John Von Bergen, *Chem. Eng.*, Aug. 1957, pp. 239-250.
Discusses effective methods for control of industrial odors; combustion, adsorption, absorption, odor masking, odor counteraction. Advantages and disadvantages in addition to information on installation and operation of equipment. Excellent coverage of the field.

Dust Collectors

General

"When it Comes to Gas Scrubbers—Fit the Material to the Service," *Plant Eng.*, Oct. 1955, pp. 106-107.
Materials of construction; types of contaminants.

"Characteristics of Commercial Air Cleaners," First, M. W., and Leslie Silverman, *Heating and Ventilating*, Jan. 1954, pp. 78-81.

Important features of commercial air cleaners in common use are grouped for easy comparison in an extensive table; costs; capacity; air velocity; pressure drop.

"Dry Dust Collectors for Industry," J. M. DallaValle, *Heating and Ventilating*, June 1952, pp. 103-114.
Principles, design and applications of dry inertial and motor powered separators; design equations; theory; cyclone collectors; performance and applications; effect of temperature.

"Eliminate Stack Dusts and Mists," H. W. Danser, Jr., *Chem. Eng.*, May 1950, pp. 158-160.
Sonic agglomeration; efficiency, theory; application; case histories.

"Filter Type Dust Collectors," L. J. Weischhaus, *Chem. Eng.*, Aug. 1947, pp. 113-115.
Theory, applications and recent developments of filter type collectors; methods of cleaning; air-cloth ratio; maintenance.

"Terminal Velocity as the Measure of Dust-Particle Characteristics," R. B. Foley, *Transactions of the A.S.M.E.*, Feb. 1947, pp. 101-108.
Methods of particle size analysis; measuring terminal velocity of particles; action of centrifugal collectors; efficiency.

Selection

"Guideposts Tell How to Select Dust Collecting Equipment," J. M. Kane, *Plant Eng.*, Nov. 1954, pp. 106-111.
Selection; particle size vs. collector type; fire hazards; operating efficiency of various types of collecting equipment; application vs. type of collector; maintenance; installation.

"Guides in Dust Collector Selection," J. M. Kane, *Heating and Ventilating*, Oct. 1954, pp. 77-82.
Dust characteristics; gas stream characteristics; dust collector characteristics; application vs. type of collector; installation and maintenance.

"Rating Selection and Use of Panel Type Air Filters," C. B. Rowe, *Heating and Ventilating*, Jan. 1951, pp. 58-63.
Selection and use; performance vs. design, type of dust being collected; test methods for experimental data.

Performance

"Ceramic Fiber Filter Passes A. E. C. Test . . . Removes 99% of Fine Dust From 1400° F Air," *Chem. Processing*, Jan. 1956, pp. 50-51.
Description of application and performance.

"What Would You Do?—Replies to Engineering and Operating Problems of Interest to the Industrial Plant Engineer," N. N. Wolpert, *Air Cond., Heating and Ventilating*, Sept. 1955, pp. 103-105.
Table of comparison of dust collector characteristics.

"Performance of Wire-Mesh Demisters," *Chem. Eng. Progress*, Aug 1954, pp. 421-424.
Case histories for chemical plant and oil refinery installations are presented; design formula; description of wire-mesh demisters; pressure drop; efficiency; costs.

"Performance of Inertial Collectors," Leslie Silverman, *Heating and Ventilating*, Feb. 1953, pp. 87-92.
A discussion of fundamental factors in the performance of inertial collectors for the removal of particulate matter. Tables present performance data for a number of collectors based on both field tests and manufacturer's ratings. Chamber dimensions; design formulas.

"Operation, Application and Effectiveness of Dust Collection Equipment," J. M. Kane, *Heating and Ventilating*, Aug. 1952, pp. 87-98.
Selection; particle size vs. type of collector; efficiency; costs; types; applications; pressure drop; selection and maintenance; comparison of dust collector characteristics.

Cyclone Separators

General

"Wet Cyclones," Tangel, O. F., and R. J. Brison, *Chem. Eng.*, June 1955, pp. 234-238.
Classification in the 5-150 micron range; thickening; operating and design variables; cyclone variations; installation; maintenance; application; multicyclones, performance and operation.

Design

"A Graphical Method of Sizing Cyclone Dust Collectors," *Heating and Ventilating*, Mar. 1951, pp. 104-106.
Equations for design.

"The Design and Performance of Cyclone Separators," C. J. Stairmand, *Trans. Inst. Chem. Eng.* **29**, 356-383 (1951).
General mechanism of operation of cyclone dust collectors is described and performance data for some practical designs are presented. The main factors affecting the efficiency of cyclones are discussed, and experimental support is given for views expressed regarding the most efficient design.

"Design of Exhaust Systems," F. H. Stebbins, *Sheet Metal Worker*, Feb. 1949, pp. 40-42.
Details of a system which failed to operate; an account of changes needed to remedy the trouble; general discussion of good design for exhaust systems.

"Cyclone Dust Collector Design," M. W. First, *American Society of Mechanical Engineers, Paper No. 49-A-127*, Nov. 27-Dec. 2, 1949.
Velocity, pressure, flow direction and dust gradients were measured in geometrically designed cyclones of graduated size and in cyclones embodying changes in characteristic dimensions. The effect of cyclone size, shape and air flow rate on cyclone energy loss and efficiency are related to the internal dynamics of the collector. An energy loss equation in terms of cyclone dimensions is developed.

"Factors in the Design of Cyclone Dust Collectors," First, M. W., and Leslie Silverman, *Heating and Ventilating*, July 1948, pp. 80-86.
Basic factors in the design and performance of cyclone dust collectors; theoretical and empirical formulas for cyclone performance; types of cyclones; cyclone variables; performance; flow pattern; separating efficiency; pressure loss.

Entrainment Separators

General

"Finding Limiting Velocity in Liquid Entrainment Separators," Robert Hlavin, *Chem. Processing*, Aug. 1954, p. 184.
Nomographic solution.

"Entrainment Separation," C. F. Montross, *Chem. Eng.*, Oct. 1953, pp. 213-236.
A comprehensive survey of types, design and performance of liquid entrainment separators. Particle characteristics; tabular listing of types of separators giving various characteristics useful in selection and design; impingement separators; scrubbers, listing selection and design data for various types; operation and performance of electrostatic precipitators; comparison of various types; costs; materials of contruction; derivation of design equations.

Flow Formulas for Air

Maxey Brooke, Chemical Engineer, Sweeny, Tex.
(For author biography see Chem. Eng., July 1957, p. 318.)

36. Low Pressure Air Flow Through Straight Circular Ducts

FORMULA

$$Q = 87\sqrt{\frac{(P_1^2 - P_2^2)d^5}{WL(1 + 3.6/d)}}$$

REFERENCE

W. C. Unwin, *Proc. Inst. Gas Engrs.*, (London), June 12, 1904, pp. 852–67.

NOMENCLATURE

- d Diameter of duct, ft.
- L Length of duct, ft.
- P_1 Upstream pressure, lb./sq. ft.
- P_2 Downstream pressure, lb./sq. ft.
- Q Volume of air at pressure P_2, cfs.
- W Density of air at ambient temperature and mean pressure of P_1 and P_2, lb./ cu. ft.

37. Discharge of High Pressure Air to Atmosphere Through an Orifice

FORMULA

$$W = 76.36ACP/T$$

REFERENCE

Ice & Refrigeration, **78**, 2, 151–5 (1930).

NOMENCLATURE

- A Orifice area, sq. ft.
- C Constant: 0.98 for well-rounded orifices or 0.65 for sharp-edged orifices.
- P Upstream pressure, psia.
- T Upstream temperature, deg. F. absolute.
- W Discharge, lb./sec.

38. Flow of Air in Pipes

FORMULA

$$P = \frac{1.268(t + 460)Q^{1.962}L}{10^6(p + 14.7)d^{4.979}}$$

NOTE

For pressure drops of several psi. as occurs in plant utility compressed air systems.

NOMENCLATURE

- d Diameter of pipe, in.
- L Length of pipe, ft.
- P Pressure drop, psi.
- p Mean gage pressure, psi.
- Q Free air flow at 60 F. and 1 atm., cfm.
- t Mean air temperature, deg. F.

REFERENCE

McMillan, *Eng. News-Record*, **91**, 178 (1923).

39. Air Required to Lift Water

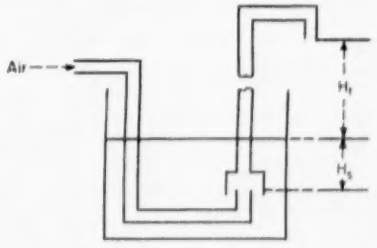
FORMULAS

$$V = 0.8\left[\frac{H_t}{C\log\left(\frac{H_s + 34}{34}\right)}\right]$$

$$S = \frac{100H_s}{H_t + H_s}$$

Use These Values for Constant

S %	C Air Line Outside Water Line	C Air Line Inside Water Line
35	216	162
40	246	185
45	272	204
50	296	228
55	318	262
60	325	285
65	348	306
70	358	322
75	366	330



NOMENCLATURE

- C Constant from table
- H_s Distance from water surface to point of air inlet, ft.
- H_t Distance from water surface to point of discharge, ft.
- S Submergence, %
- V Free air required to lift one gal. of water, cu. ft.

REFERENCE

"Air Lift Catalog No. 77," Ingersoll-Rand Co.

How the Series is Organized

Random Packed Towers

Gas-Liquid Systems
Liquid-Liquid Systems

Stacked Towers
Reactors

Fixed and Moving Beds

Fluidized Systems

General Characteristics
• Numerical Calculations

How to predict the start of fluidization and estimate fluidization mass velocity, expanded bed height, nature and significance of fluidization efficiency in fluid-solids systems. Solved problems illustrate methods given in this article.

FLOW THROUGH PACKINGS AND BEDS

Correlations in Fluidized Systems

MAX LEVA, Consulting Chemical Engineer, Pittsburgh, Pa.*

In last month's article (*Chem. Eng.*, Oct. 1957, p. 289), we discussed the qualitative behavior of fluidized beds. We now discuss the correlations which permit us to predict the onset of fluidization, and the estimation of fluidized bed height.

Onset of Fluidization

When a bed of solids is at incipient fluidization, the pressure drop is then very nearly equal to

$$\Delta P_f = L(1 - \epsilon)(\rho_S - \rho_F) \qquad (1)$$

At this state the bed is still fixed. If we assume that the fluid rate is low enough so that laminar flow still persists, the pressure drop is also equal to

$$\Delta P_f = \frac{200G\mu L(1 - \epsilon)^2}{D_p^2 \rho_F g_c \phi_S^2 \epsilon^3} \qquad (2)$$

Upon equating Eqs. (1) and (2) and solving for mass velocity, there results

$$G = 0.005 \frac{D_p^2 g_c \rho_F (\rho_S - \rho_F) \epsilon^3 \phi_S^2}{\mu(1 - \epsilon)} \qquad (3)$$

This equation is important because it permits us to predict the onset of fluidization of a granular charge. It is also useful for examining whether, and if so how far, flow through expanded beds adheres to fixed bed behavior.

Minimum Fluidization

The state of incipient fluidization is termed minimum fluidization.[5] Eq. (3) permits estimation of a minimum fluidization mass velocity G_{mf}, if particle sphericity and voidage of the bed at the point of minimum fluidization are available.

Measurements of sphericity of solids have resulted from fixed bed pressure drops. Estimates of minimum fluid voidage are made by intensely fluidizing the granular solids and slowly reducing the gas flow to zero. In this way the solids settle gradually to a condition of bed density that may be considered reasonably close to the minimum fluidized bed voidage.

Typical values of ϵ_{mf} are given in Fig. 1 for a variety of materials of known sphericity. These values are related to the particle diameter D_p.

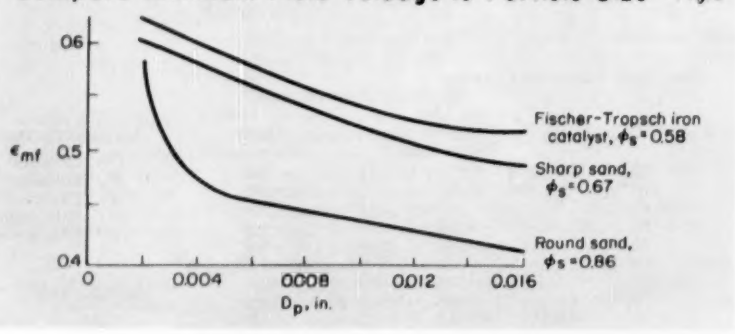
From a consideration of the data of Fig. 1 and use in Eq. (3), it is now evident that mere bed expansion is not sufficient to induce fluidization. Another requirement is that the solids bed must be at the minimum fluidized bed voidage ϵ_{mf}.

If the solids bed is below ϵ_{mf}, expansion must proceed until ϵ_{mf} is reached (compare Figs. 2*a*, and 2*b*, *Chem. Eng.*, Oct. 1957, p. 290). The dependence of ϵ_{mf} on D_p and ϕ_S is to be expected and may be qualitatively explained from particle surface area-energy relationships at the point of initial fluidization.[5]

Whereas Eq. (3) is wholly satistory for estimating G_{mf}, it still requires knowledge of ϕ_S and ϵ_{mf}, quantities which are not always readily evaluated. This is especially true for vesicular materials.

Voidage and material density determinations for these materials will always lead to greater or lesser errors. These errors result from the fact that measured porosity is affected by a proportion of voids that pertain to the inside of the particles. These voids are,

Compare Minimum Fluid Voidage to Particle Size Fig. 1



*For author biography see *Chem. Eng.*, July 1957, p 316.

therefore, not ordinarily available to fluid flow.

For this reason the composite particle bed property as given by the product $\phi_s^2\epsilon^3/(1-\epsilon)$ may be expressed for any particle shape as a function[5] of D_pG/μ. When this function is then substituted into Eq. (3), there results

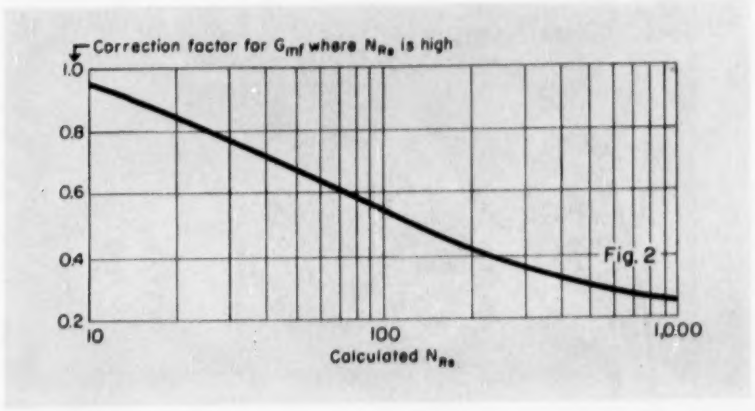
$$G_{mf} = 688 D_p^{1.82} \frac{[\rho_F(\rho_S - \rho_F)]^{0.94}}{\mu^{0.88}} \quad (4)$$

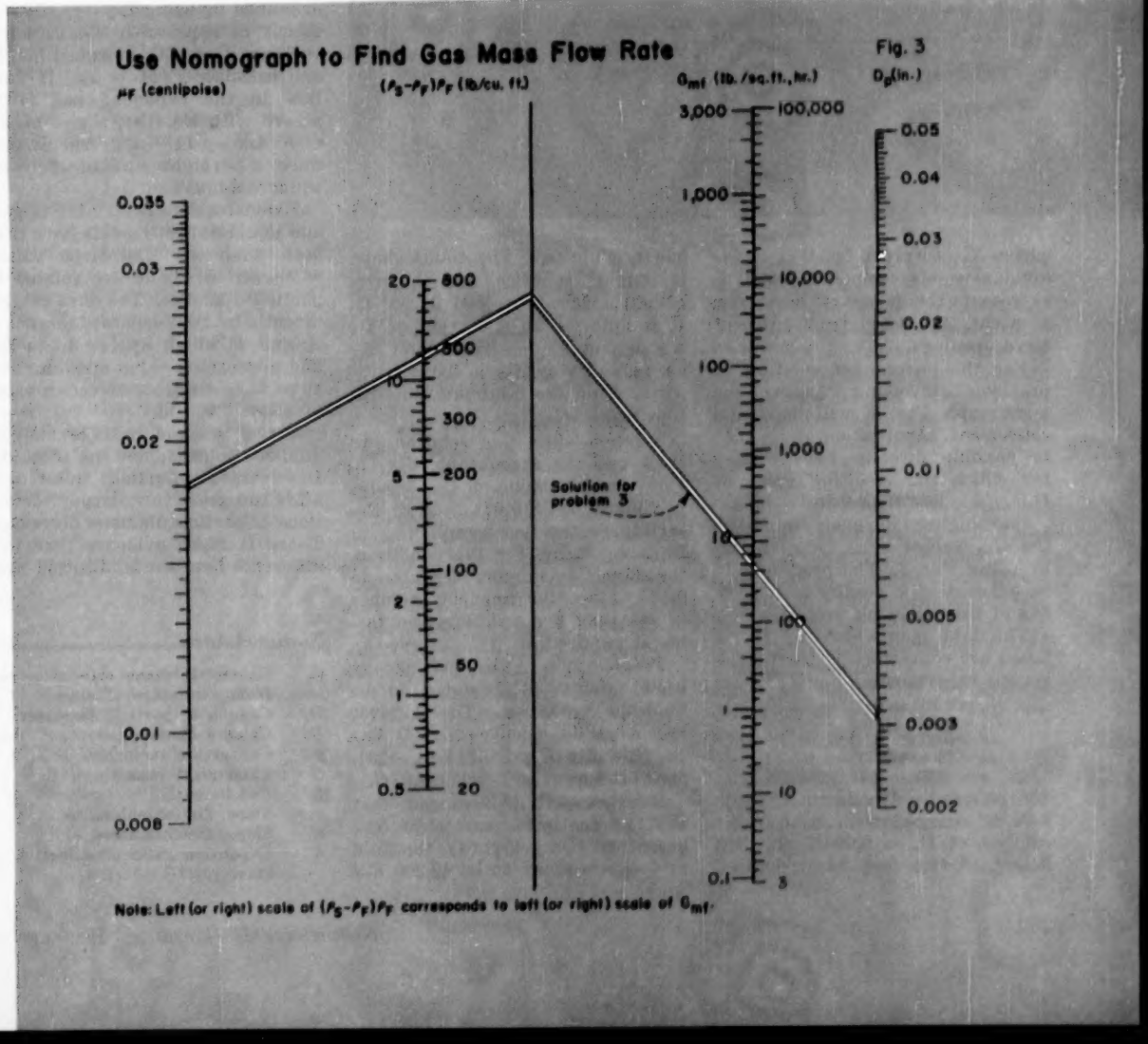
If in this equation D_p is expressed in in., ρ_s and ρ_F in lb./cu. ft., and the fluid viscosity μ in centipoises, G_{mf} is given in lb./sq. ft.-hr. The non-dimensional character of the expression results merely from the choice of units and the inclusion of g_c in the experimental constant.

Eq. (4) is virtually based on all available literature data. It applies equally satisfactorily to vesicular as well as non-vesicular materials. Solids density is determined by a pycnometer, using mercury as the fluid.

Particle diameter for a mixture of particle is calculated by

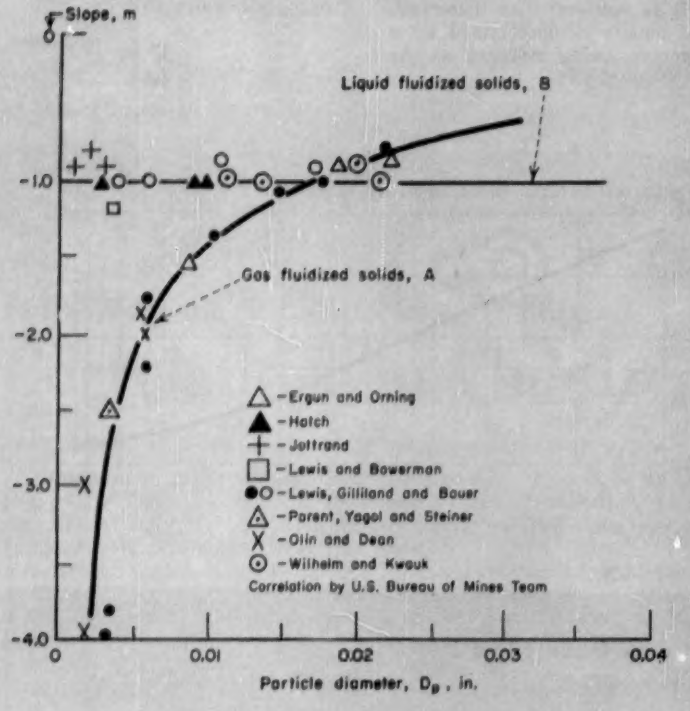
$$D_p = 1 \Big/ \sum \frac{X_n}{d_n}$$





Use Slope Values to Find Bed Expansion

Fig. 4



where X_n is weight fraction of individual solids components and d_n represents the geometric mean size of a cut; calculated from adjacent sieve openings.

For the purpose of solution of problems involving gases, the nomograph Fig. 3 will be found convenient. Application of Eq. (4) is possible directly to any case for which the resulting value of $D_p G_{mf}/\mu$ is less than five.

For higher Reynolds numbers, the G_{mf} values must be corrected by using Fig. 2. The procedure to be adhered to is readily seen from one of the following problems.

The data upon which Eq. (4) is based are characterized by the following experimental limits:

D_p = 0.205 to 0.002 in.
D_t = 0.5 to 6.0 in.
ρ_f = 0.005 to 62.3 lb./cu. ft.
ρ_s = 70 to 673 lb./cu. ft.
μ = 0.022 to 2.42 lb./hr.-ft.

Problem 1—A column of 4-in. I.D. is charged with a granular catalyst of D_p = 0.00430 in. Bed height is two feet when dumped and prefluidized. The solids shape is roughly spherical and the pycnometric density is 300 lb./cu. ft. It is fluidized by a current of air whose average density is 0.071 lb./cu. ft. and viscosity is 0.018 centipoise. Find the minimum fluidization mass velocity.

Solution—For this solution, we shall use the nomograph Fig. 3. First find the value of $(\rho_s - \rho_f)\rho_f = (300 - 0.071)0.071 = 21.3$. Resorting to the nomograph, G_{mf} = 20 lb./sq. ft.-hr. For this condition, the Reynolds number $D_p G_{mf}/\mu$ = 0.164. Since the Reynolds number is less than five no correction factor is required.

Problem 2 — A bed of Socony bead catalyst is intended to be fluidized by water. The catalyst has a solids density of 100 lb./cu. ft. and a D_p of 0.174 in. Estimate the required value of G_{mf}.

Solution — It is assumed that μ = 1.0 centipoise and ρ_f = 62.3 lb./cu. ft. Using Eq. (4), the fluid rate G_{mf} is found to be 42,200 lb./sq. ft.-hr. The Reynolds number $D_p G_{mf}/\mu = (0.174 \times 42{,}200)/(12 \times 2.42) = 253$. Since the Reynolds number is in excess of five, the value of G_{mf} must be corrected.

From Fig. 2, the correction factor is found to be 0.375. Multiplying the mass flow rate G_{mf}, previously found, by the correction factor gives G_{mf} = 42,200 x 0.375 = 15,800 lb./sq. ft.-hr. It is interesting to observe that this result is determined without using quantities such as column height, column diameter and void space.

Wilhelm and Kwauk[3] fluidized such a catalyst in a 6-in. diameter column with water. Their experimental data report a value of G_{mf} of about 17,000 lb./sq. ft.-hr. which compares favorably with the calculated value.

Gas-Solid Bed Expansion

As already stated the expansion of the solids bed may readily be examined by using Eq. (3). It will simply be required to evaluate bed voidages from the expanded height and calculate $\epsilon^3/(1 - \epsilon)$. If fluid flow in the expanded bed is in accord with Eq. (3), a plot of log G versus log $(1 - \epsilon)/\epsilon^3$ should produce a straight line of slope m equal to minus one.

Extensive data pertaining to gas- and liquid-fluidized solids have thus been analyzed. The slope values m shown in Fig. 4 are related to particle diameter. The data exhibit essentially two separate branches A and B which appear to merge and approach a value of minus one as particle diameter exceeds a value of about 0.015 in.

For all sizes of particles, liquid-fluidized solids follow the equation. However, gas-fluidized solids exhibit progressively larger deviations as particle diameter decreases. There is much evidence that this difference between fluidization with

Nomenclature

d_n	Geometric mean size of a cut, from a mixture of sizes.
D_p	Composite particle diameter.
D	Column diameter.
g_c	Conversion factor.
G	Fluid mass velocity.
L	Bed height.
m	Slope, dimensionless.
n	Slope, dimensionless.
R	Expansion ratio of a bed, $R = (1 - \epsilon_{mf})/(1 - \epsilon)$.

gases and liquids is related to homogeneity of void space in the bed. Thus this difference may be another expression of the already mentioned aggregative and particulate behavior of fluidized systems.

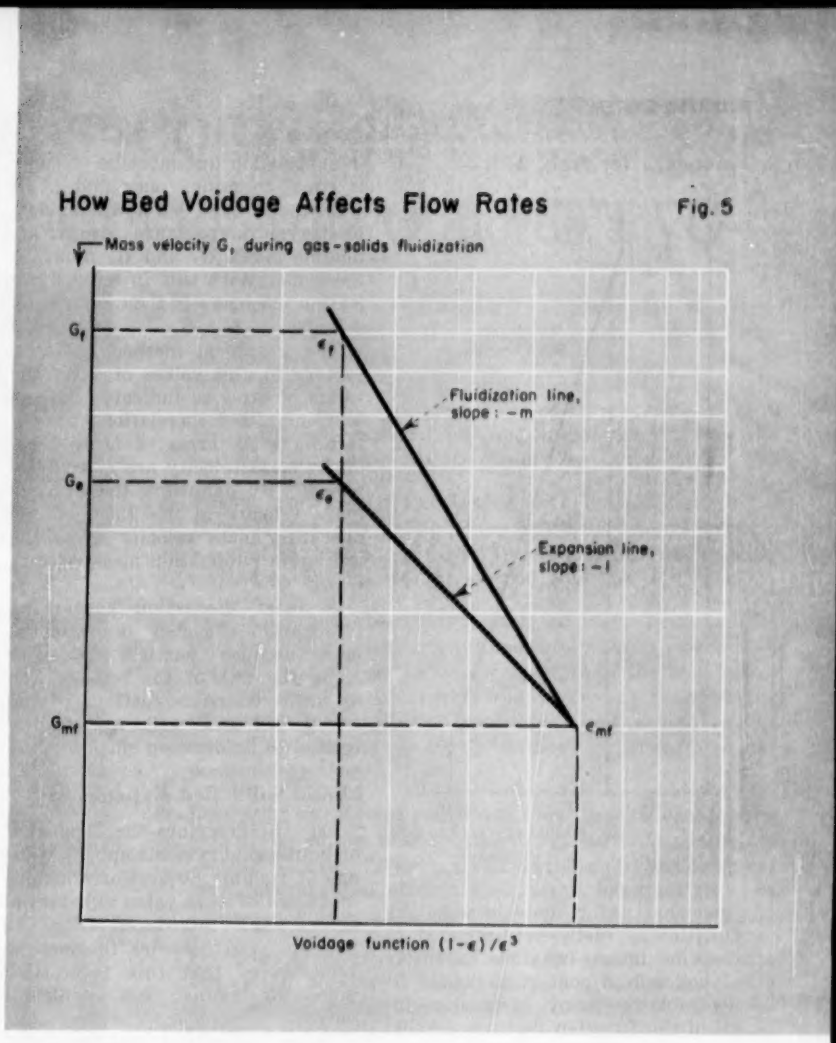
From purely visual observation, it is well known that the particle movement appears more intense in gas- than in liquid-fluidized systems. Moreover, considering gas-fluidized solids it is also known that internal agitation increases as particle diameter decreases.

Of the several interpretations offered regarding the deviations, only the flocculation theory of Morse[4] need be mentioned. Morse assumes formation of solid complexes (composed of individual particles) are hydrodynamically active rather than the individual particles.

While this may explain the trend of the deviations another corollary requirement, namely that the complexes must grow in size as gas rate increases, is difficult to accept. Perhaps this concept may in some sense be equivalent to an increase in the state of aggregation of the bed.

As far as estimation of bed expansion is concerned, analytical equations have been developed on the basis of the data of Fig. 4.[5] Entirely generalized correlations are presented elsewhere.[6] Instead of giving these here, a graphical solution is presented that will also be useful for another purpose.

In order to evaluate bed expansion for a solid of diameter D_p, one first evaluates G_{mf} preferably by Eq. (4). Thereafter ϵ_{mf} is estimated for the material for which a shape factor value has been visually found.[3] Then using logarithmic coordinates G_{mf} is plotted versus $(1 - \epsilon)/\epsilon^3$. From Fig. 4, the slope m for the desired conditions is found. Then a straight line of slope m is placed through the starting point. The line shown in Fig. 5 is termed the fluidization line. Obviously, it relates mass flow rate values with respective values of bed voidage ϵ. The expansion ratio is then given by $R = (1 - \epsilon_{mf})/(1 - \epsilon)$.



For conditions where a gross voidage in excess of about 65% results, there is at present no reliable method of predicting expansion behavior. The top of the bed may vary considerably, a phenomenon which is related to slugging.

The correlations discussed pertain wholly to non-baffled beds. For gas-solid systems that carry baffles smooth expansion, without excessive fluctuations of the top of the bed, is possible to considerably higher bed voidages. Just how far baffled beds may expand smoothly will depend on the type and size of solids handled and especially the type of baffle employed.

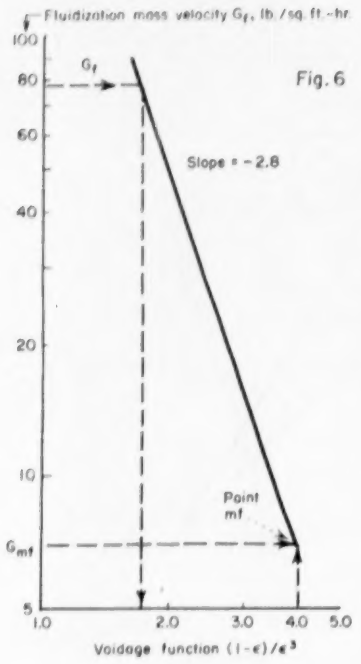
Fluidization Efficiency

Visual examinations of gas-fluidized systems show that for a fixed velocity the solids convection currents in a bed appear to increase in intensity as particle diameter decreases. Solids movement within the bed is one of the essential features of fluidization. Therefore definition of a quantity that may have a bearing on the intensity of the solids convection currents is desirable. This is what the function that has earlier been termed the fluidization efficiency accomplishes.[6]

The terminological choice is

N_{Re}	Reynolds number, D_pG/μ.
X_n	Weight fraction of solids component.
Δp_t	Theoretical pressure drop.
ϵ	Bed voidage.
ϵ_{mf}	Minimum fluid bed voidage.
η	Fluidization efficiency.
μ	Fluid viscosity.
ρ_F	Fluid density.
ρ_S	Solids density.
ϕ_S	Sphericity factor of particles.

Voidage, ϵ for Prob. 3



somewhat unfortunate because the function is really not intended to describe in any way the intensity of solids-fluid contact as would be desirable in many instances. Instead the function pertains wholly, as systematic experiments[1] have since definitely indicated, to the overall velocity of the solids past the confining wall and brought about by fluid passage.

Further proof of the physical significance of the fluidization efficiency function is also presented by successful correlations of virtually the entire repertoire of fluidized bed-exterior wall heat transfer data.[6, 7]

In addition to the fluidization line G_{mf}-G_f, Fig. 5 also contains what is termed an expansion line G_{mf}-G_o. Along the fluidization line values of bed voidage in terms of the function $(1 - \epsilon)/\epsilon^3$ have been related with values of operating mass velocities of the fluid bed. Hence these mass velocities both expand the bed and set the particles in motion.

Along the expansion line G_{mf}-G_o, however, such values of gas mass velocity are related to the voidage ϵ. These velocities merely expand the bed and do not set the particles into motion. Obviously the expansion line must be of slope m equal to minus one; and is in accord with fixed bed flow behavior. Furthermore pressure drops attending flows G_f and G_o must be the same. With this in mind fluidization efficiency is then defined by $\eta = (G_f - G_o)/G_f$.

The graphical method is satisfactory to give values of η for the range of sizes as indicated in Fig. 4. Generalized correlations for obtaining η in terms of D_p and reduced mass velocity are given elsewhere.[7] By definition the reduced mass velocity is the ratio of the operating mass velocity G_f to the minimum fluidization mass velocity G_{mf}.[7]

A brief discussion concerning fluidization efficiency is presented here because particle velocities along the wall of the bed, as well as heat transfer coefficients between bed and wall, are readily related to fluidization efficiency.[7]

Liquid-Solid Bed Expansion

Eq. (3) describes the expansion of liquid-solid systems up to a voidage of roughly 80%. For voidages in excess of this value substantial errors will be introduced if Eq. (3) is used. Furthermore it must be remembered that this application holds for laminar flow conditions only.

Some theoretical and semi-theoretical approaches have been suggested that permit evaluation of expanded bed heights at elevated voidage ranges. However, from the practical engineering point of view, of all developments the work of Richardson and Zaki[5] is most useful. On the basis of an examination of a large repertoire of data, they found that straight lines result when the logarithm of the modified Reynolds number is plotted versus the logarithm of the bed voidage.

Furthermore the slopes of the lines are dependent on the Reynolds number range and other quantities as follows:

For the range

$$0.2 < N_{Re} < 1$$

$$n = \frac{(4.35 + 17.5D_p/D_t)}{N_{Re}^{0.03}}$$

For the range

$$1 < N_{Re} < 200$$

$$n = \frac{(4.45 + 18D_p/D_t)}{N_{Re}^{0.1}}$$

For the range

$$200 < N_{Re} < 500$$

$$n = 4.45/N_{Re}^{0.1}$$

Where the Reynolds number is greater than 500, the slope n is constant and equals 2.39.

Problem 3—A fluidization vessel of 4.0 in. I.D. is charged with 2,355 grams of round sand of D_p equal to 0.0031 in. and gives a column 0.786 ft. high. The bed is fluidized with air at a mass velocity of 77 lb./sq. ft.-hr. Temperature and pressure of the system are 76 F. and 740 mm. respectively. Specific gravity of the sand is 2.65.

Find the expanded bed height.

Solution—Gas density ρ_f corrected to 76 F. and 740 mm. equals 0.0720 lb./cu. ft. We shall use the nomograph Fig. 3 to obtain G_{mf}. Thus $(\rho_s - \rho_f)\rho_f = 11.9$. Assume $\mu = 0.018$ centipoise. Then $G_{mf} = 7.0$ lb./sq. ft.-hr. The modified Reynolds number equals 0.00075. Hence G_{mf} needs no correction.

Since this is a rounded granule the voidage $\epsilon = 0.50$ as found from Fig. 1. Hence $(1 - \epsilon)/\epsilon^3 = 4.0$. With these two coordinates, Point mf is located in Fig. 6.

From Fig. 4, $m = -2.8$. This slope permits drawing the fluidization line as shown in Fig. 6. At an air mass velocity of 77 lb./sq. ft.-hr., the fluidization line in Fig. 6 yields a value of the function $(1 - \epsilon)/\epsilon^3$ of 1.72. Hence the voidage $\epsilon = 0.61$. The expansion ratio of the bed becomes $R = (1 - \epsilon_{mf})/(1 - \epsilon) = 1.28$.

Bed height as calculated from ϵ_{mf} values is as follows:

Bed weight 2,355/453 = 5.2 lb. With an apparent density of 82.5 lb./cu. ft., the volume is 0.0622 cu. ft. Since the column cross section is 0.087 sq. ft., the height of the bed is 0.715 ft. The expanded bed height is then 0.715 x 1.28 = 0.915 ft. This is in good agreement with an experimentally determined value[3] of 0.943 ft.

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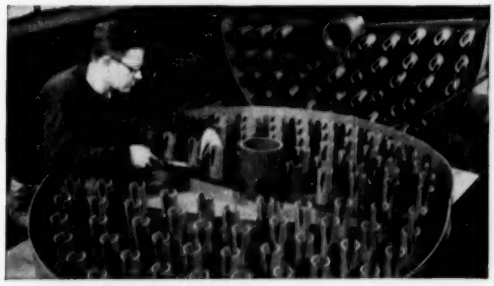
BEAT CORROSION

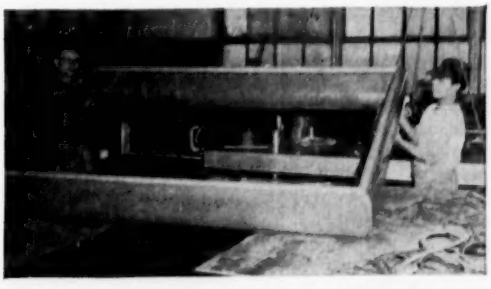
5 ways easier with Ryertex Omicron PVC

Bending Type 1 PVC pipe around wooden jig



Welding PVC distributor plate for chlorine stripping tower

PVC rod is ideal for many anti-corrosive screw machine products



Workman easily lifts PVC tank enclosure during fabrication

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2. **Forms easily**—After softening in a hot oil bath, rigid Ryertex-Omicron PVC pipe is easily bent around a simple wooden jig (see photo). Sheets and rods are also readily formed by heating to between 200° and 260° F.

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Do You Know How to . . .

Calculate area of pipe in double-pipe heat exchanger

Determine by graphical integration $A = \int_{75}^{250} \frac{Wc_p\,dt}{u(t_s - t)}$

Find flow characteristics in conduits

By graphical integration find $KE = (\rho/2gc) \int_0^1 u^3 dy$

IF YOU CAN'T INTEGRATE DIRECTLY

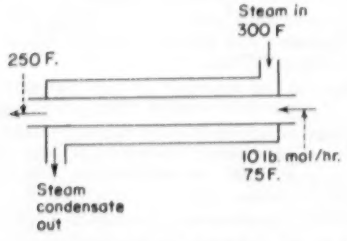
Solve Equations Graphically

WILLIAM E. BALL and R. CURTIS JOHNSON, Washington University, St. Louis, Mo.*

In this article we intend to digress a bit from our straight and narrow path leading from formulation to analytical solution of differential equations. Perhaps this problem justifies the side journey we have chosen to follow:

Problem 1—Calculate the area of pipe necessary in a double-pipe heat exchanger to heat 10 lb. mol./hr. of a gas from 75 to 250 F., using 300 F. steam. Use the following properties:

T	460	480	510	560	610	660	760
c_p	7.00	7.10	7.25	7.50	7.75	8.00	8.50
U	6.30	6.38	6.51	6.70	6.87	7.02	7.33



Solution—At a point in the above exchanger

$$dq = Wc_p\,dt = U(t_s - t)\,dA \qquad (1)$$

where q = heat transferred, Btu./hr.; W = flow rate, lb. mol./hr.; c_p = heat capacity, Btu./lb. mol.-deg. F.; t = temperature, deg. F. (or T, deg. R.); U = over-all coefficient, Btu./hr.-sq. ft.- deg. F.; t_s = steam temperature, deg. F. and A = heat transfer area, sq. ft.

* For authors' biographies, see *Chem. Eng.*, Sept. 1957, pp. 343-44.

The integral necessary to solve Eq. (1) is

$$A = \int_{75}^{250} \frac{Wc_p\,dt}{U(t_s - t)} \qquad (2)$$

Up to this point, we find that the analysis is straightforward and that it is easy to indicate the solution. Actual evaluation of the numerical solution is a different matter. We have two courses.

(1) We can try to fit c_p and U by some type of mathematical expression which will allow direct integration.

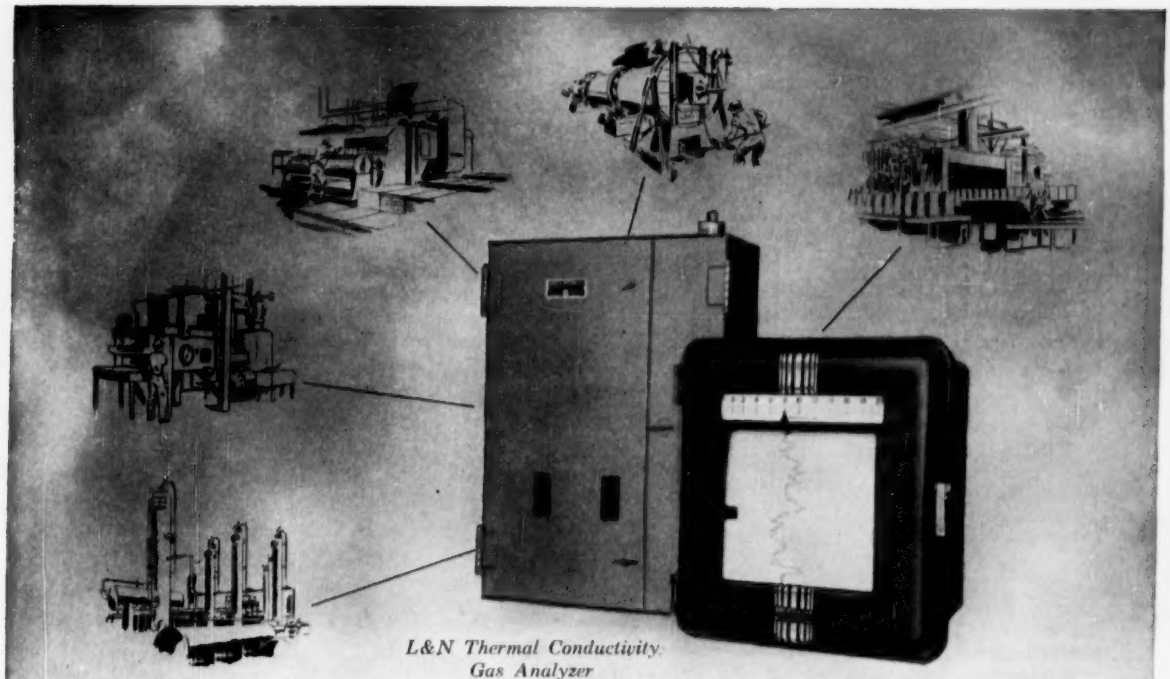
(2) We can try other methods of integration such as numerical or graphical methods.

Since these techniques of curve fitting and graphical methods are an important and integral part of the solution of many applied problems, we discuss these methods now.

Sooner or later in most problems one or more plots are necessary. Sometimes the plots are the desired result of the calculation. Graphs of results show relationships and trends more easily than do tabulations of numbers. At other times plots are merely a part of a problem solution, and are of little importance in the final results. Such techniques as graphical differentiation and integration fall into this category.

Straight Line Plots

Whenever it is necessary to handle data graphically, it is always desirable—although not always possible—to plot the data in such a form as to give a straight line. This technique serves one or more of three purposes.



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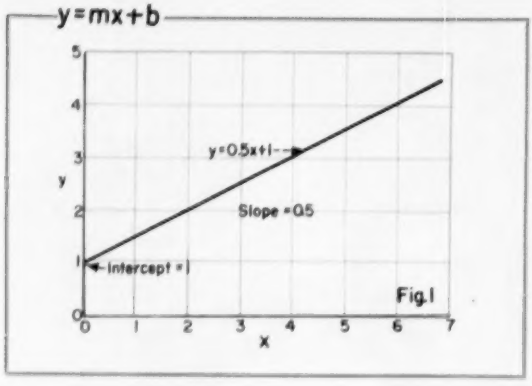


(1) Extrapolation and interpolation are made easier and more reliable.

(2) Mathematical relationships between the variables may usually be easily determined from the plot.

(3) When the general form of the relationship is known, the graph may be valuable in determining the accuracy of the data, or in deciding which points may be in error.

A complete understanding of the graph of a linear function makes the study of complicated functions much easier. When y and x are related by

$$y = mx + b \tag{3}$$

y is usually plotted vs. x on rectangular coordinate paper, as in Fig. 1. When $x = 0$, $y = b$. On the plot, then, b is read directly as the value of the intercept on the y axis at the point $x = 0$.

The value of the slope m may be found mathematically by choosing any two points on the line (x_1, y_1) and (x_2, y_2) and writing the equations

$$\left.\begin{aligned} y_2 &= mx_2 + b \\ y_1 &= mx_1 + b \end{aligned}\right\} \tag{4}$$

Then solving the equations gives the slope

$$m = (y_2 - y_1)/(x_2 - x_1) \tag{5}$$

It should be emphasized that the slope m is a mathematically defined value. The actual geometric slope of the straight line is equal to m only if the x and y scales are identical. In this case only, it is often convenient to measure the distances $(y_2 - y_1)$ and $(x_2 - x_1)$ with a ruler and take the ratio to obtain m. It should also be noted that b may be calculated after m is found. This is often preferable to extrapolation to find the y-intercept.

The above principles are not changed in any way when more complicated relationships between y and x exist. An equation often encountered in chemical engineering is

$$y = ax^m \tag{6}$$

where a and m are constants. When logarithms are taken

$$\log y = \log a + m \log x \tag{7}$$

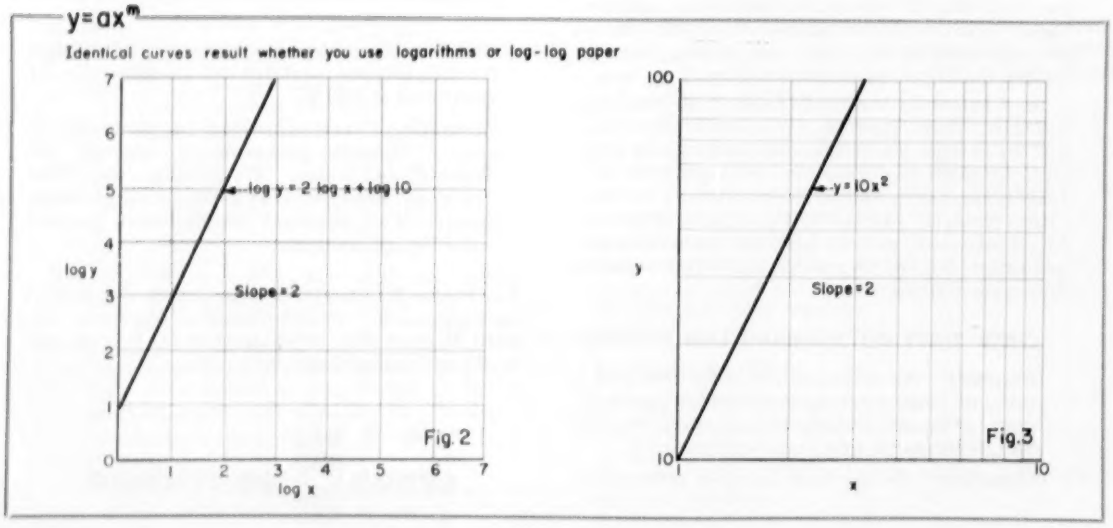
This equation is linear in $\log y$ and $\log x$. Therefore a plot of $\log y$ vs. $\log x$ is a straight line. Also, when $\log x = 0$, $\log y = \log a$. Note that $x = 1$ when $\log x = 0$. Further when two equations are written as in Eqs. (4), it is found that

$$m = (\log y_2 - \log y_1)/(\log x_2 - \log x_1) \tag{8}$$

A plot of $\log y$ vs. $\log x$ is shown in Fig. 2 for the function $y = 10x^2$. In Fig. 3, this function is again plotted for comparison with Fig. 2. The actual determination of logarithms is avoided by using log-log paper as shown in Fig. 3. Thus much labor is saved. These points should be noted:

(1) In Fig. 2, when $\log x = 0$, $\log y = a$. To find a, the antilog must be taken. In Fig. 3, the value of a is read directly at the point where $x = 1$.

(2) In Fig. 2 the logs of x_1, y_1, x_2 and y_2 are read directly so that m may be calculated from Eq. (8). In Fig. 4 the actual values of x and y are read and logs are taken before m is found. On a log-log plot m may be found by dividing the distance between y_1 and y_2 by the distance between x_1 and x_2. This



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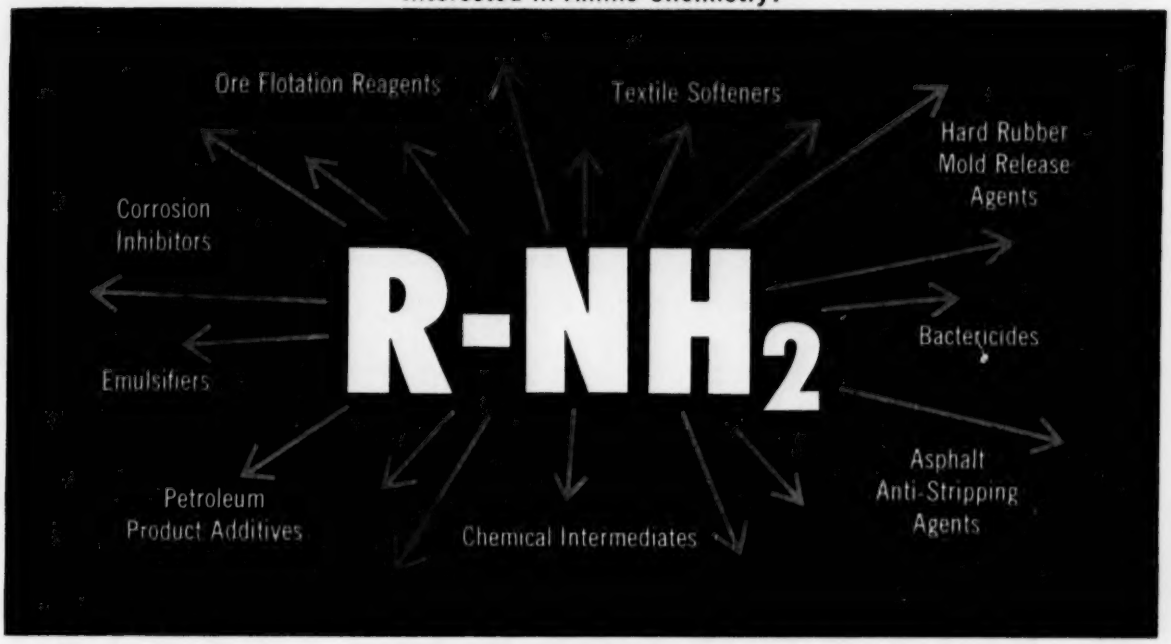

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Primary stearylamine	Alamine 7	186 min.	6 max.
Primary coco amine	Alamine 21	250 min.	16 max.
Primary tallow amine	Alamine 26	192 min.	35 min.
Primary hydrogenated tallow amine	Alamine H26	192 min.	6 max.
Primary cotton amine	Alamine 33	192 min.	65 min.
DISTILLED GRADE—97% Min. Primary Amine Content			
Primary laurylamine	Alamine 4D	294 min.	2.0 max.
Primary palmitylamine	Alamine 6D	225 min.	2.0 max.
Primary stearylamine	Alamine 7D	202 min.	6 max.
Primary coco amine	Alamine 21D	272 min.	16 max.
Primary tallow amine	Alamine 26D	207 min.	35 min.
Primary hydrogenated tallow amine	Alamine H26D	207 min.	6 max.
Primary cotton amine	Alamine 33D	207 min.	65 min.
MIXED AMINES 60% min. primary amine content	Alamine 46	150 min.	20 min.

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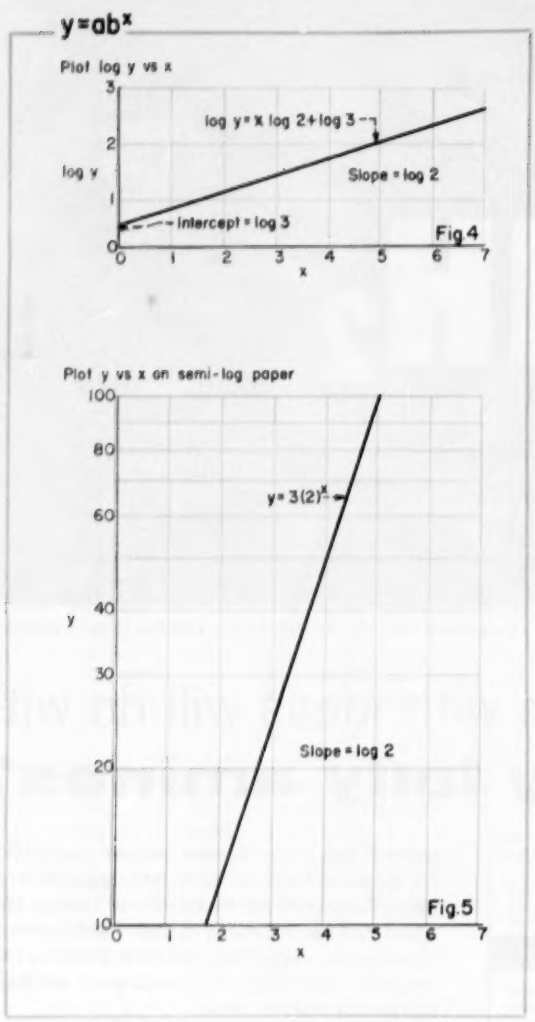

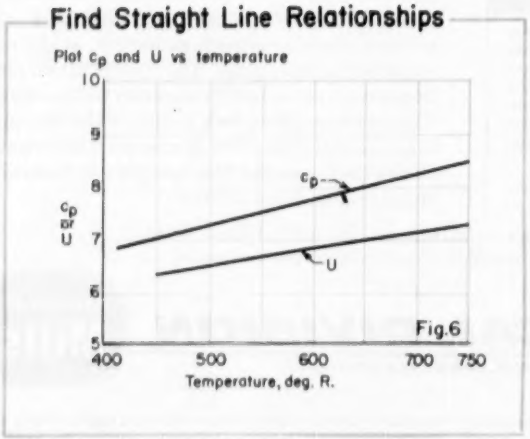

can be done only if the length of the cycles in one direction is the same as that in the other direction.

(3) As in the case for the linear equation, it is often easier to calculate a after m is found than to find a by extrapolation.

Another relationship occasionally encountered is

$$y = ab^x \tag{9}$$

where a and b are again constants. Again taking logs

$$\log y = \log a + x \log b \tag{10}$$

where $\log y = \log a$ when $x = 0$

and

$$\log b = (\log y_2 - \log y_1)/(x_2 - x_1) \tag{11}$$

From these equations it is evident that to obtain a straight line log y should be plotted vs. x. Also the value of a or log a may be found from the intercept where $x = 0$, or calculated after b is determined.

As in the previous case, a special graph paper semilog is made for plotting functions of this form. Thus, the data will give a straight line if log y is plotted vs. x on rectangular coordinate paper; or y is plotted vs. x on semilog paper. In Figs. 4 and 5, the function $y = 3\ (2)^x$ is plotted.

Example Illustrates Methods

Problem 2—If possible determine the straight line relationships for c_p and U in *Problem* 1.

Solution—We know that c_p is a function of temperature. We know that U is a complex function involving many variables. In this problem the only independent variable, which is changing, is the temperature. Therefore, we will try to obtain a relationship of U with temperature.

The first step is to make a plot of the dependent variable vs. the independent variable on linear paper. From the nature of the curve, it is often possible to predict the type of relationship which should be used to obtain a straight line.

The plot of c_p and U vs. T is shown in Fig. 6. We see that the plot of c_p is linear. Therefore, we may obtain the constants in the equation $c_p = mT + b$. It seems rather useless to extend the curve to obtain an intercept at T equal to zero. Therefore, we use simultaneous equations to find m and b.

When $T = 460$: $c_p = 7.00 = 460m + b$
When $T = 560$: $c_p = 7.50 = 560m + b$

From these equations, $m = 0.005$ and $b = 4.70$. Our equation now becomes $c_p = 4.70 + 0.005T$.

The linear plot of U vs. T shows that U increases with T. However, the slope decreases as T increases. A semilog plot would accentuate this curvature. A log-log plot would perhaps give a straight line. From Fig. 7, we see that the line is actually straight. Choosing the points $T = 460$, $U = 6.30$ and $T = 760$, $U = 7.33$ and using Eq. (8)

$$m = (\log 7.33 - \log 6.30)/(\log 760 - \log 460) = 0.30$$

Now using $T = 460$, $U = 6.30$ and Eq. (6), $a = U/T^m = 0.99$. Thus $U = 0.99T^{0.30}$

In many cases the relationship between y and x is not easily handled by logarithms. It is still possible, however, to find a straight-line method of plotting. For example, the Wilson method (see McAdams,[4] p. 343; or Brown,[5] p. 527) depends upon obtaining an equation of the form

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FIG. 2309—Flush Bottom Tank Valve for 150 Pounds W.P.

FIG. 2491—Stainless Steel O.S.& Y. Gate Valve for 150 Pounds W.P.

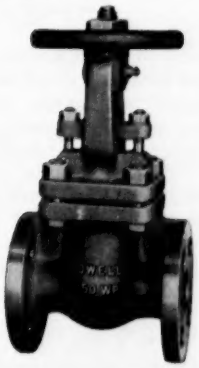
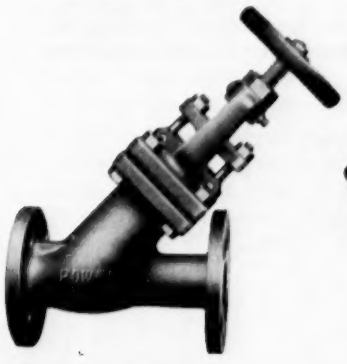


FIG. 1886—Stainless Steel Liquid Level Gauge for 350 Pounds W.W.P. Offset pattern.

FIG. 2107—Stainless Steel "Y" Valve for 150 Pounds W.P.



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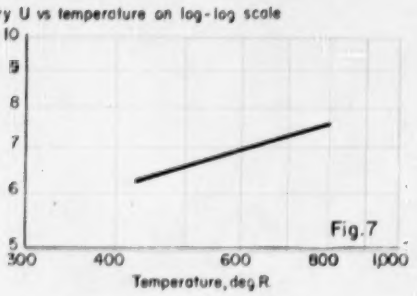
Replot U to Get Straight Line



$$1/U = b + m(1/V^n) \tag{12}$$

where a, b and n are constants. If n is known, a plot of $(1/U)$ vs. $(1/V^n)$ may be made. The intercept where $(1/V^n)$ equals zero is b, and

$$m = \frac{(1/U_2) - (1/U_1)}{(1/V_2^n) - (1/V_1^n)} \tag{13}$$

As another example, vapor pressures are sometimes expressed as

$$\log (p/c) = b + (m/T) \tag{14}$$

where p = pressure, c = concentration, T absolute temperature and b and m are constants. Eq. (14) may also be written in the form

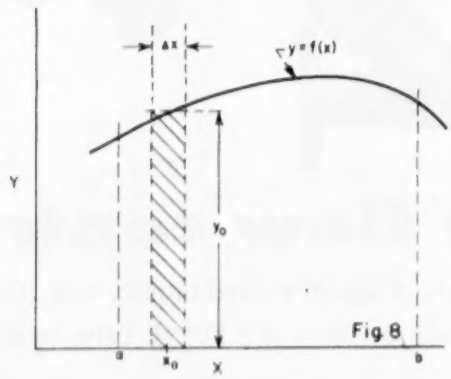
$$\log p = b + (m/T) + \log c \tag{15}$$

Since three variables are present, a plot must involve one of them as a parameter. A logical method of plotting to obtain straight lines is to plot log p vs. $(1/T)$ for various constant values of c. For pure substances c is constant; and a simpler equation applies (see Dodge[5] p. 247).

$$\log p = b + (m/T) \tag{16}$$

Further information on methods of plotting may be found in Davis[4] and in Mickley, Sherwood and Reed.[3] Reference is also made to physical chemistry texts where graphical methods are put to practical use to determine reaction orders from experimental data.

Determine Area Under Curve



Least Squares Curve Fitting

In the problems in these articles we work with exact data. We assume that all variation in our independent variables can be accounted for by variations in the independent variables. We should emphasize, however, that ordinary data will involve some unaccounted for variations. These variations are caused partly by experimental errors; and partly by variables not considered in the analysis.

While recognizing the importance of statistics and the necessity of statistical training in the background of today's engineer, we will not attempt to cover the field here. Reference is made to Mickley, Sherwood and Reed,[3] Chap. 2. A recent article by Volk[6] in *Chem. Eng.* discusses the more important statistical applications.

Graphical Integration

The idea of graphical integration is a simple one. We recall from basic calculus that if we have a relationship $y = f(x)$ which is shown in Fig. 8, we may look upon the term $y\Delta x$ as representing a small element of area ΔA.

$$y\,\Delta x = \Delta A \tag{17}$$

ΔA is approximately the area under the curve, when y is chosen as y_o, the value for x_o and the range of Δx is between $x_o - \Delta x/2$ and $x_o + \Delta x/2$. The sum of all such rectangles between $x = a$ and $x = b$ is approximately the area under the curve between these values of x.

Then if we recall the process of taking the limit as all Δx values approach zero, the sum of rectangles approaches the true area under the curve. Mathematically we can write

$$A = \lim \sum y\,\Delta x = \int_a^b y dx \tag{18}$$

When we have any single-valued function $F(x)$, the integral $\int F(x)dx$ between the limits x_1 and x_2 may still be thought of as an area. The area is determined by counting squares or using a planimeter. Three points are to be noted:

(1) On the x-axis we plot only the quantity whose differential appears in the equation. All other items of $F(x)$, except possibly constants, appear on the y-axis.

(2) The value of a unit square must be known.

(3) A careful mathematical analysis must preceed the plotting.

Examples Illustrate Graphical Integration

Problem 3—Find the value of the integral in *Problem 1* by graphical integration.

Solution—In Eq. (2) we note that W is constant at 10 lb.mol./hr. Thus

$$A = 10 \int_{75}^{250} \frac{c_p\,dt}{U(t_s - t)}$$

Upon comparison with Eq. (8), we see that t is

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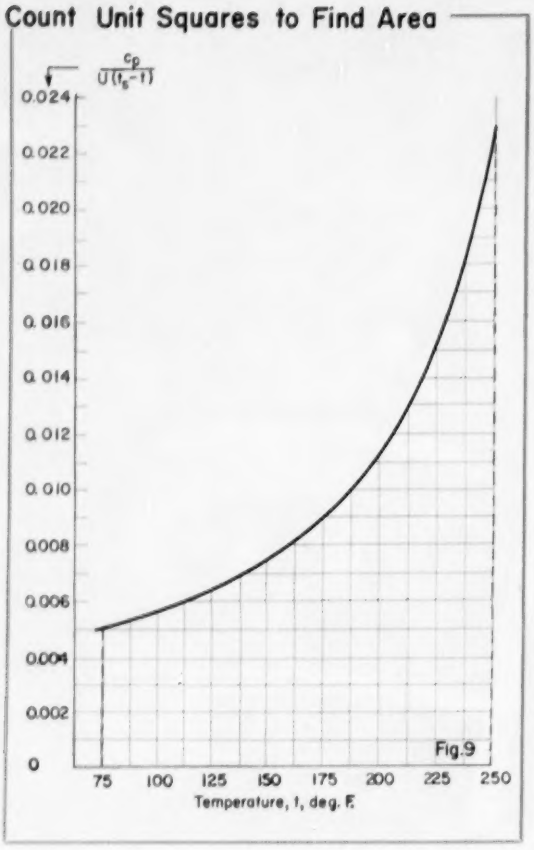
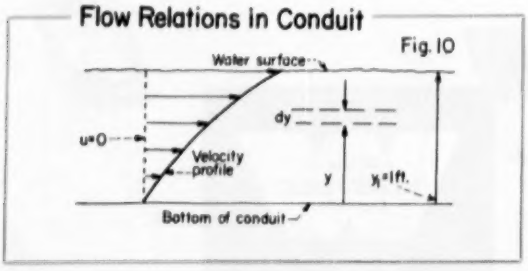


to be plotted on the x-axis and $c_p/[U(t_s - t)]$ on the y-axis.

Next we tabulate the essential values of c_p and u from Figs. 6 and 7; and make the plot shown in Fig. 9.

t	c_p	U	$(t_s - t)$	$c_p/U(t_s-t)$
75	7.375	6.60	225	0.00496
100	7.50	6.70	200	0.00560
125	7.625	6.78	175	0.00643
150	7.75	6.87	150	0.00752
175	7.875	6.94	125	0.00908
200	8.00	7.02	100	0.01140
225	8.125	7.10	75	0.01525
250	8.25	7.19	50	0.02295

From the plot, we find that the area bounded by $t = 75$ F., $t = 250$ F. and the curve of $c_p/[U(t_s - t)]$ is about 137 squares. Each unit square consists of a difference of 0.001 on the y-axis and 12.5 on the x-axis; its area is therefore 0.0125 units. The integral is then 137 × 0.0125 or 1.71 units. We did not include $W = 10$ lb.mol./hr. in the integral. Therefore $A = 10 \times 1.71 = 17.1$ sq. ft.



At this point we will be negligent if we do not indicate an engineering way of doing this problem. Approximating the answer also serves to check for any glaring errors of arithmetic in the above work. We note that neither c_p nor U varies greatly over the range of the heat exchanger. Thus we may approximate the area by using

$$A = \frac{Wc_{pa}}{U_a} \ln\left[\frac{t_s - t_1}{t_s - t_2}\right] \qquad (19)$$

Substituting average values for $c_{pa} = 7.81$ and $U_a = 6.90$ in Eq. (19), we find that the area equals 17.2 sq. ft.

Problem 4—Measurements are made of the velocity of water in a flat conduit. The following values are recorded:

y, ft. from bottom	0	0.2	0.4	0.6	0.8	1.0
u, fps.	0	0.24	0.56	0.96	1.44	2.00

For a 1-ft. wide section of the conduit calculate total mass rate of flow, mean velocity, kinetic energy and mean velocity to give the correct value of kinetic energy.

Solution—A diagram of the system is shown in Fig. 10. As a basis use a 1-ft. width of the conduit. In section dy, the rate of low dM is

$$dM = [u(1)\,dy]\rho \qquad (20)$$

Kinetic energy flow is

$$(dM)u^2/2g_c = (\rho/2g_c)u^3\,dy \qquad (21)$$

Total flow rate is

$$M = \int dM = \rho \int u dy \qquad (22)$$

Mean velocity is such that

$$[u_m(1)(y_2 - y_1)]\rho = M = \rho \int u dy \qquad (23)$$

Thus

$$u_m = \frac{\int u dy}{y_2 - y_1} = \frac{\int u dy}{\int dy} \qquad (24)$$

Total kinetic energy flow is

$$KE = (\rho/2g_c)\int u^3 dy \qquad (25)$$

We could fit curves to the data of u vs. y. However to further illustrate graphical integration we perform the plotting operation, using these data:

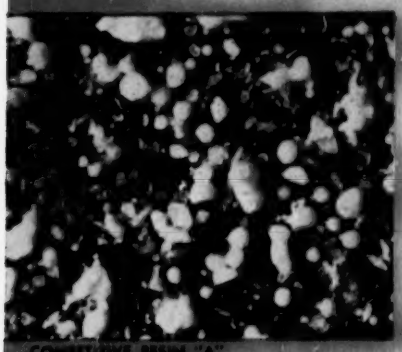
y	u	u^3
0	0	0
0.2	0.24	0.0138
0.4	0.56	0.1756
0.6	0.96	0.8847
0.8	1.44	2.9859
1.0	2.00	8.0000

The curves of u and u^3 are shown in Fig. 11.

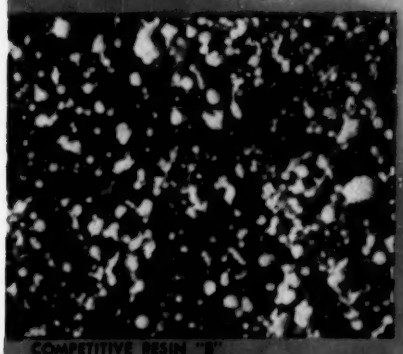
For the total mass rate of flow, the value of the integral is $\int u dy$ = (17 squares) (0.5 fps. × 0.1 ft./square) = 0.85 sq. ft./sec. From Eq. (22) M = 62.4 lb./cu.ft. × 0.85 sq.ft./sec. = 53.0 lb./ft.sec. On the basis of 1-ft. width, M is 53.0 lb./sec.

From Eq. (24) the mean velocity is u_m = (0.85 sq.ft./sec.)/(1 ft.) = 0.85 fps.

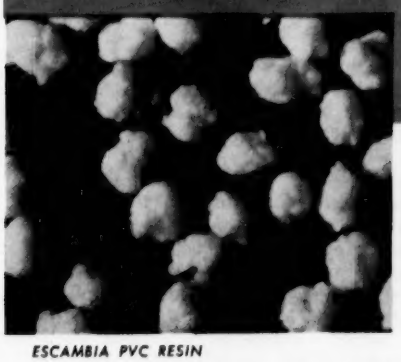
For the total kinetic energy, the value of the



COMPETITIVE RESIN "A"



COMPETITIVE RESIN "B"



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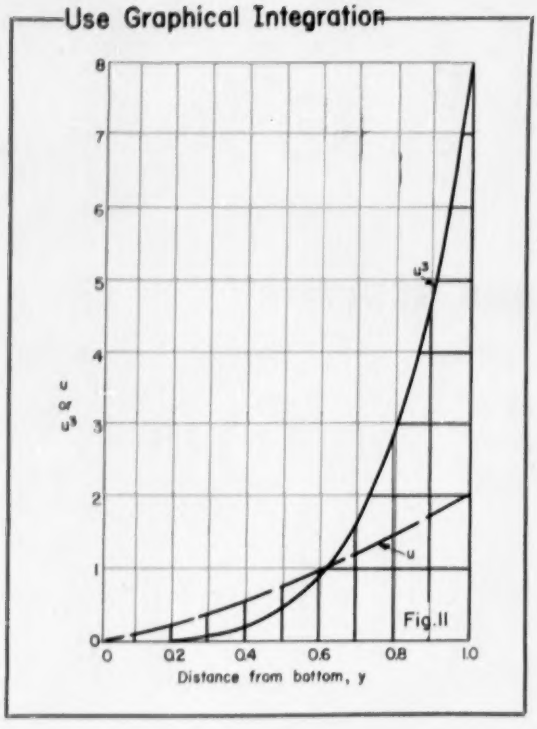
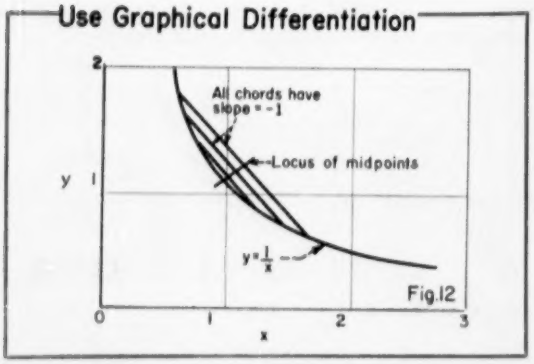


integral is $\int u^3 dy$ = (30.3 squares) (0.5 ft.^{3}/sec.^{3} × 0.1 ft./square) = 1.52 ft.^{4}/sec.^{3} Then substituting in Eq. (25), the kinetic energy is 1.47 ft.-lb.$_f$/ft.-sec. For a 1-ft. width, the kinetic energy equals 1.47 ft.-lb.$_f$/sec. Note that the example is clearer when we label carefully the force and mass pounds.

If we wished to use the equation $KE = Mu^3/2g_c$, the mean velocity u_m is 1.337 fps. Note that this does not correspond to the average velocity of 1.0 fps., the midpoint velocity of 0.75 fps. or the mean velocity of 0.85 fps.

This is an important point. The chemical engineer is accustomed to using $u^2/2g_c$ for kinetic energy in the mechanical or total energy balance. In this case the term is essentially correct if the flow is turbulent. If it is laminar the kinetic energy is given by u^2/g_c. In both cases u is actually the mean velocity u_m calculated on bulk flow through the pipe. Some texts use u^2/ag_c where a is a correction factor (see Dodge,[5] p. 311).

We repeat our point made in connection with graphical integration and equally applicable to any other problem solution. A careful mathematical analysis must be made prior to performing the mechanics of solution.



Graphical Differentiation

Up to now we have considered the problem of calculating the integrated value of some variable from point values. In some cases, we know the integrated values but want to calculate the point values. A simple example of this latter problem is: knowing the distance an object moves as a function of time, how do we calculate its velocity? The velocity is the derivative of distance with respect to time. Thus the problem is to differentiate the distance data.

Just as for integration, if the differentiation cannot be done analytically, then either a graphical or numerical approach can be used.

In graphical integration we made use of the fact that the integral of a function can be interpreted as the physical area under the function when it is plotted as a curve. For graphical differentiation we shall use the identification between the derivative of a function and the slope of the function when plotted as a curve.

The same care about the difference between the actual slope and the geometric slope that was mentioned in the section on plotting is required here. They are the same only if the scale of the ordinate and abscissa are the same.

The first and perhaps the most obvious method is to plot the function. Then to obtain the slope, we move a straightedge around a point on the curve until it is judged by eye to best represent the slope. Since this tangent line is straight, its slope can be easily calculated by the methods covered in the section on plotting. Eq. (5) is useful here.

A somewhat better method is to pick a slope. Then find what point on the curve has this value for its derivative. To help in finding the exact point of tangency, draw a series of chords parallel to the tangent. The curve formed by their midpoints is extrapolated to intersect the function curve. The following example illustrates this method.

Problem 5—At what point does the function $(1/x)$ have a derivative equal to minus one?

Solution—The method is illustrated in Fig. 12 which gives us the answer as equal to 0.97. Here we find the method in error by 3%, since the correct answer is 1.00.

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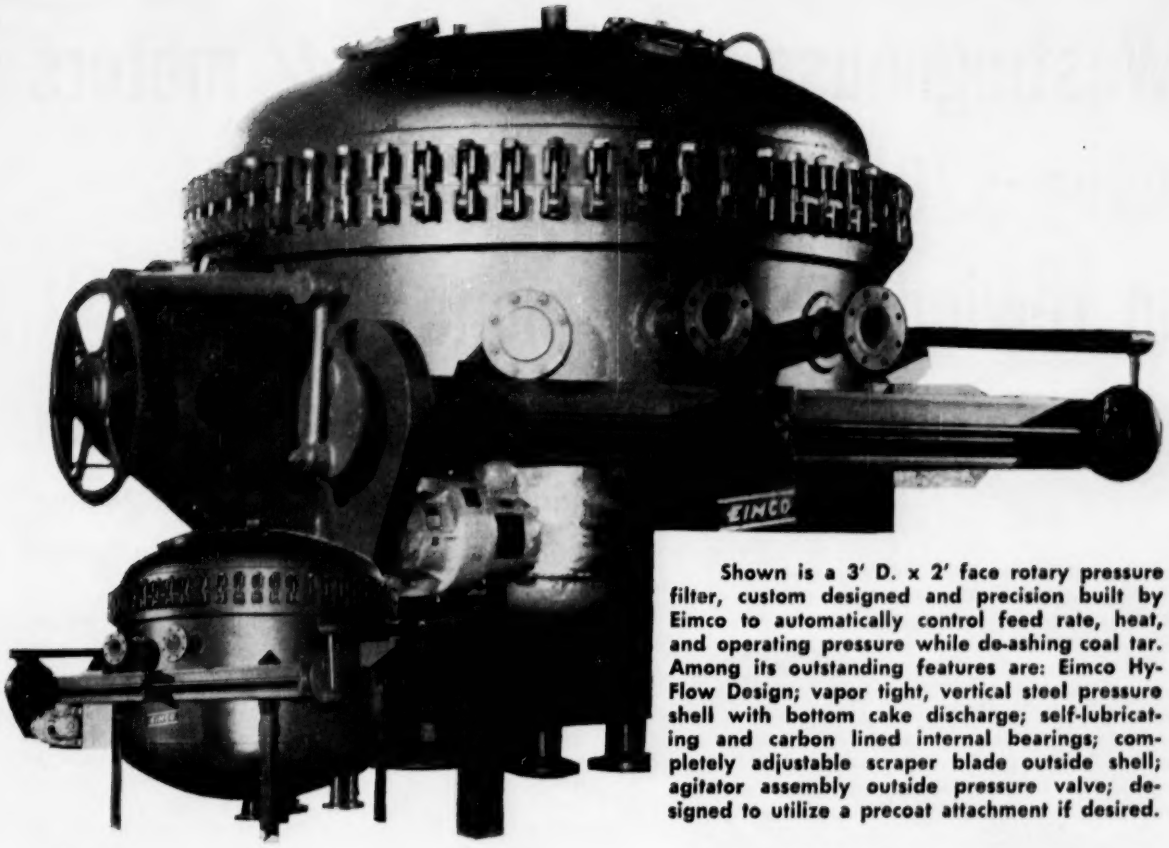

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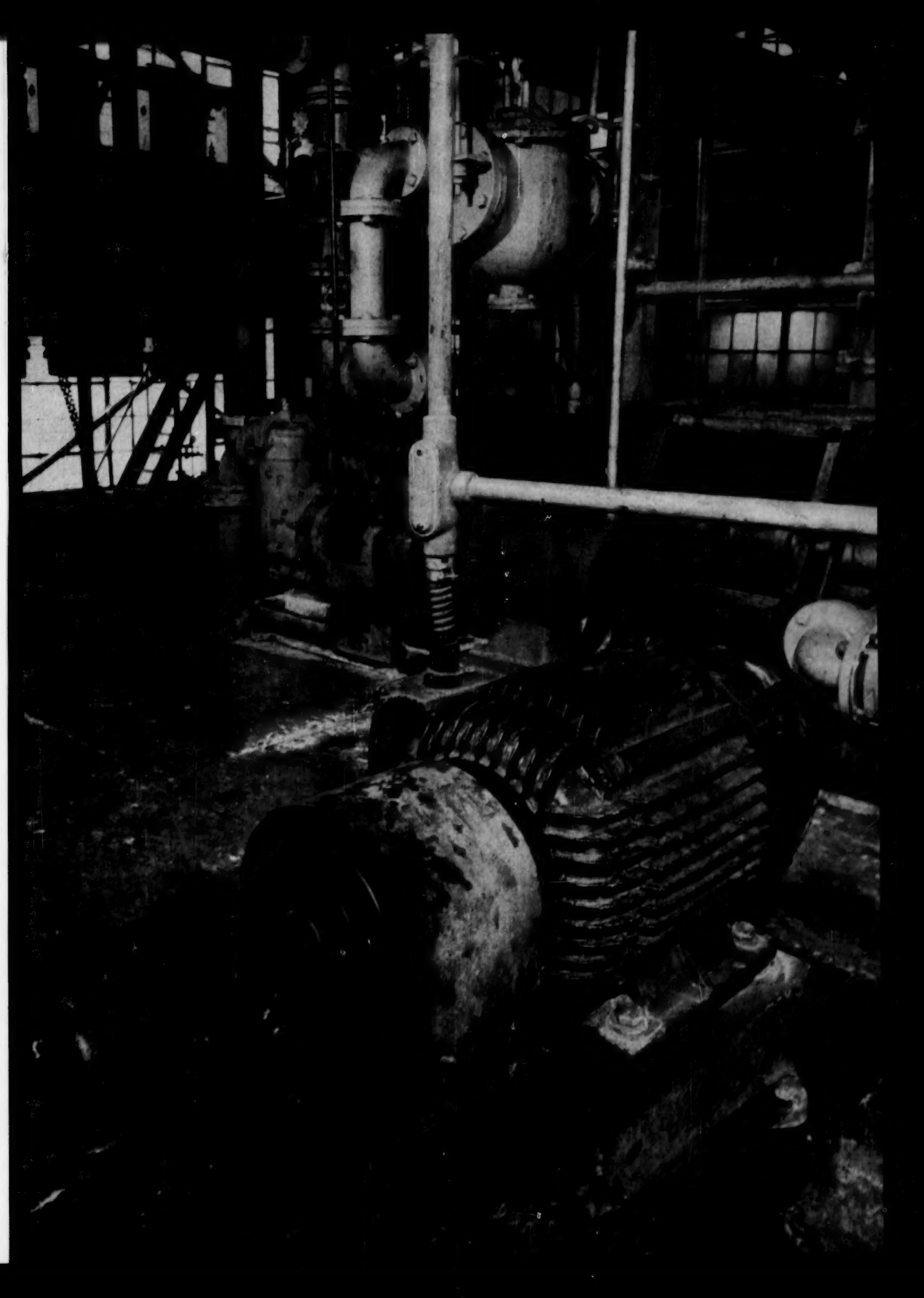
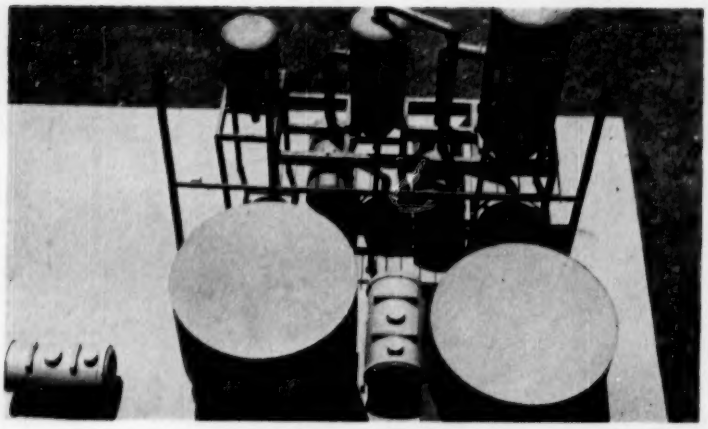
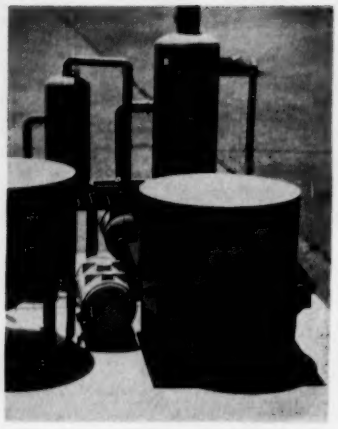


PRACTICE . . .

PLANT NOTEBOOK EDITED BY T. R. OLIVE





Scale Models Help Plan Equipment Replacement

In addition to normal use in planning new construction, models can solve unusual replacement and revamp problems.

★Winner of August Contest by
J. J. Seidel
Maintenance Supervisor, Monsanto Chemical Co., Monsanto, Ill.

Scale models of new plant installations and facilities have for years helped the design engineers and sales personnel to show accurately how new installations would appear. These models, besides their demonstration ability, have saved costly design, drafting, and field changes. If savings can be realized using scale models on new work, why cannot the same ideas be applied to unusual repairs, replacement, or alterations to existing facilities?

Recently, at Monsanto Chemical Co., we were faced with the problem of replacing two condenser-reboilers in a multi-effect evaporator. The condensers were 6 ft. and 8 ft.-6 in. in diameter by 14 ft. long, and weighed 32 and 42 tons respectively. To further complicate the replacement, the units were suspended from the second level building steel, working space was at a premium, and production downtime had to be kept at a minimum at any cost. Any number of handling methods were hatched, but the best two appeared to be: (1) Lay in a temporary railroad track, and physically move our units on a set of railroad car wheels (four wheels); and (2) move the units on a low-bed heavy-duty float.

During the hatching of ideas someone made an offhand remark, "Why don't you have a scale model built?" This remark paid off; we cut our originally estimated time by two-thirds and costs by 50%.

We had a scale model built from available drawings and then took it out into the field and checked it for accuracy. With the model, shown above, we eliminated the railroad track idea, and established that we could handle one old unit out of the building and its replacement unit into the building by using a low-bed float.

Note how the model showed

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By C. W. ROOS, Winner of the September Contest

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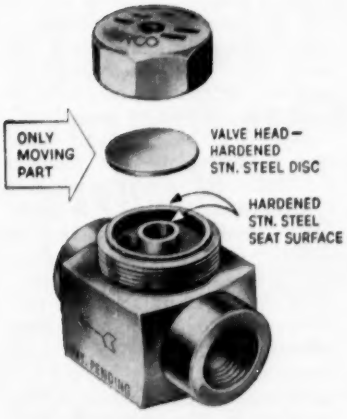

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the problem of removing the old units and installing the new ones, and how it emphasized the close clearance in the foreground.

The model also brought to light our rigging problem in lifting the units. Checking into this, we discovered our suppliers planned to ship the units upside down, using the saddles the units would be hung from to anchor them to the railroad car.

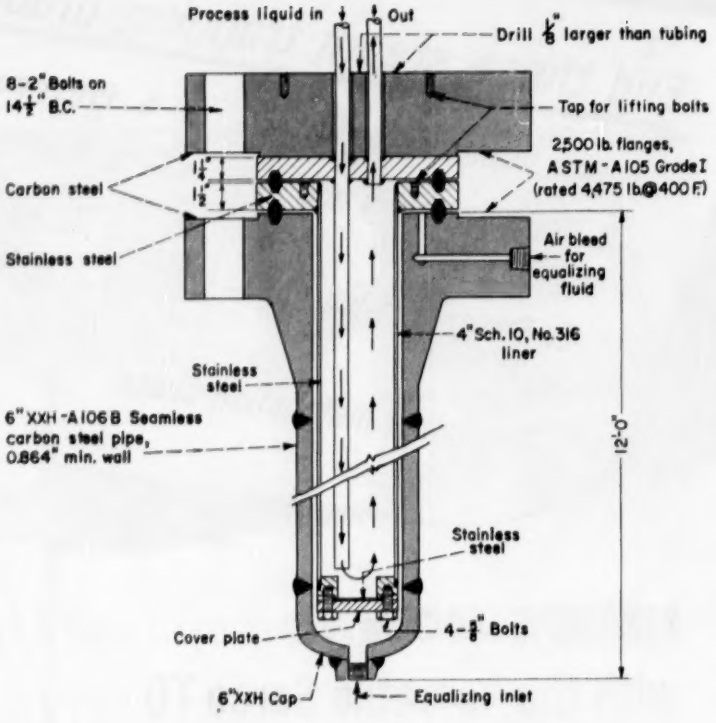
Therefore, with our model as a guide, we designed temporary steel saddles on which the condensers could be shipped and handled in an upright position. Using a model as a guide, we detailed every step involved.

We ended up using the model for two more purposes. First, we went through the job with the foreman involved, actually removing and replacing pieces, step by step as we had written up the job. This actually showed the foreman better than we could ever have explained why each phase had to follow in steps as outlined, why equipment that was to be replaced had to be stored at a specific spot, and where and why his cranes, air compressor, etc., were to be spotted at specific positions.

Our second usage of the model was as a gift and expression of thanks to the rigger shop steward for display in his shop area. In the future his crews would remember the excellent job they had turned in on this project.

No, we did not turn in an errorless project; we discovered a few items that will be checked more closely the next time. What were the errors? First, we found you must make a physical check as to size on all major pieces of equipment you rent. We found our equipment rental supplier was off 18 in. on the height of his low-bed float. Also, we found you had best allow 1 ft. minimum for clearance. When using our scale model, we allowed 6 in. after our field check, but somehow lost it in the accuracy of our model.

In general, we feel that our scale model was a useful tool in many ways. Needless to say, our next unusual maintenance job will be handled in the same manner.



Balanced Pressure Simplifies Reactor

Albert W. Spitz
Consulting Engineer, Elkins Park, Pa.

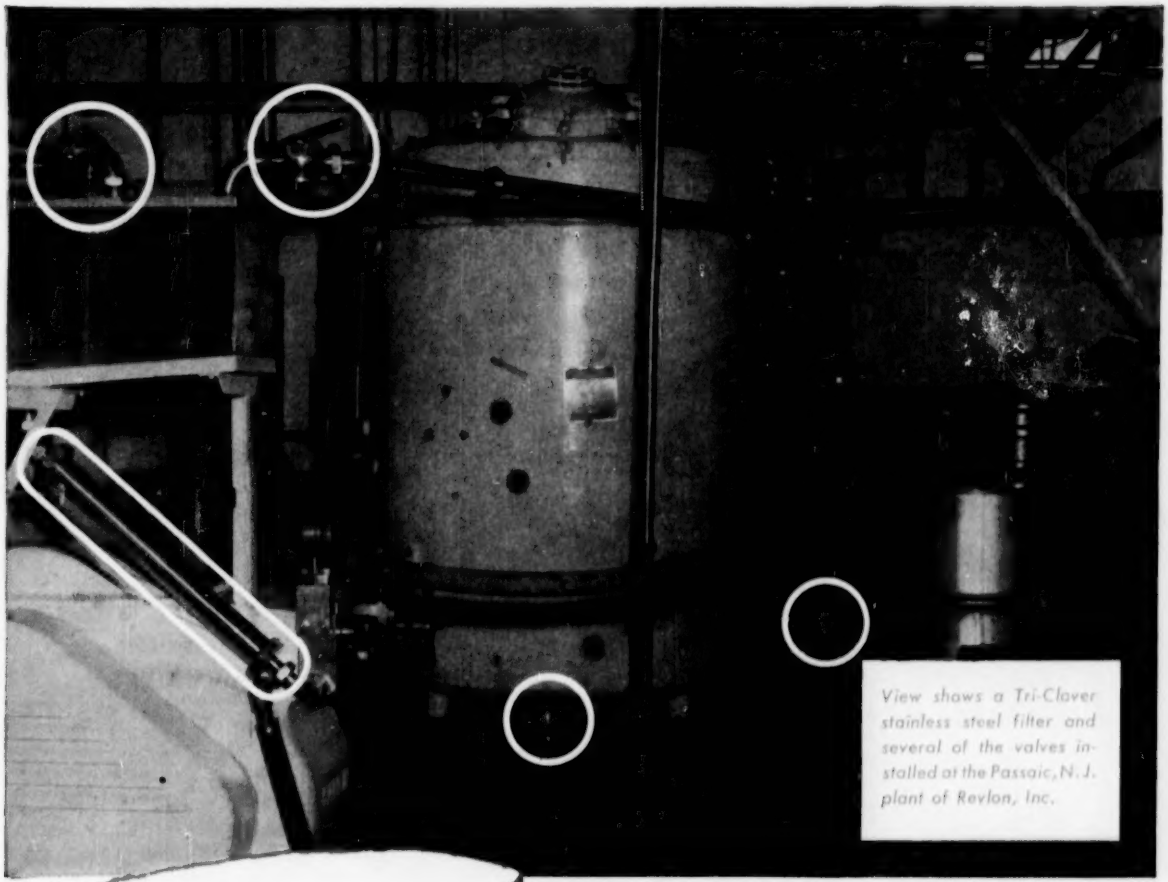
The reactor sketched above represents a comparatively simple and inexpensive solution to a problem of one of my clients which required a stainless steel reactor to operate at 3,800 psi.

A solid stainless steel reactor for this purpose could not have been built for less than $3,000, and its delivery time would have been many weeks. This design cost slightly under $2,000, and was built in three weeks.

As the sketch shows, the pressure-withstanding member is a casing of 6-in. XXH seamless carbon steel pipe. Within this is a liner of 4-in. Sch. 10 stainless steel in which the reaction takes place, with the pressure equalized inside and outside the liner. In operation, the process liquid at 3,800 psi. is pumped through a catalyst filling the liner. The space between the liner and the 6-in. shell—about 0.2 in.—is filled with an inert liquid that is immiscible with the process liquid. It is tied into the pump discharge by means of a leg in the main line in such a way that there will be no carryover of sealing liquid into the main flow. For this particular process, tricresyl phosphate is used for sealing or equalizing.

Design of the pressure shell was according to the formula $t = PR/(SE - 0.6P)$, where t is shell thickness, in.; P is working pressure, psi. (taken at 4,000); R is the inside radius, in. (2.45 for 6-in. XXH pipe); S is allowable unit stress, psi., taken at 15,000; and E is joint efficiency, taken at 1.0 for the seamless pipe used. Hence, $t = 4{,}000 \times 2.45/(15{,}000 - 2{,}400) = 0.778$ in. Since the wall thickness of 6-in. XXH pipe is 0.864, this pipe is satisfactory for the service.

Catalyst is easily charged by removing the liner and filling through the bottom cover plate. The reactor 6-in. shell carries a Hartford stamp and has operated successfully over two years.



View shows a Tri-Clover stainless steel filter and several of the valves installed at the Passaic, N.J. plant of Revlon, Inc.

TRI-CLOVER
FITTINGS and VALVES protect product quality for *Revlon* Inc.

LADISH CO.
Tri-Clover Division
Kenosha Wisconsin

I-157

REVLON—"the greatest name in cosmetics" has established an enviable reputation for highest quality products in the field of cosmetics and beauty preparations.

In the modern and efficient Revlon plant at Passaic, N.J., are numerous Tri-Clover Division stainless steel fittings, valves, and filters, all helping to protect the inherent high quality of hand creams and lotions bearing the famous Revlon label.

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Our experienced engineering service is at your disposal to help solve *your* specific corrosion-resistant piping problems.

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See the TRI-CLOVER Division Exhibit at the 1957 CHEMICAL SHOW

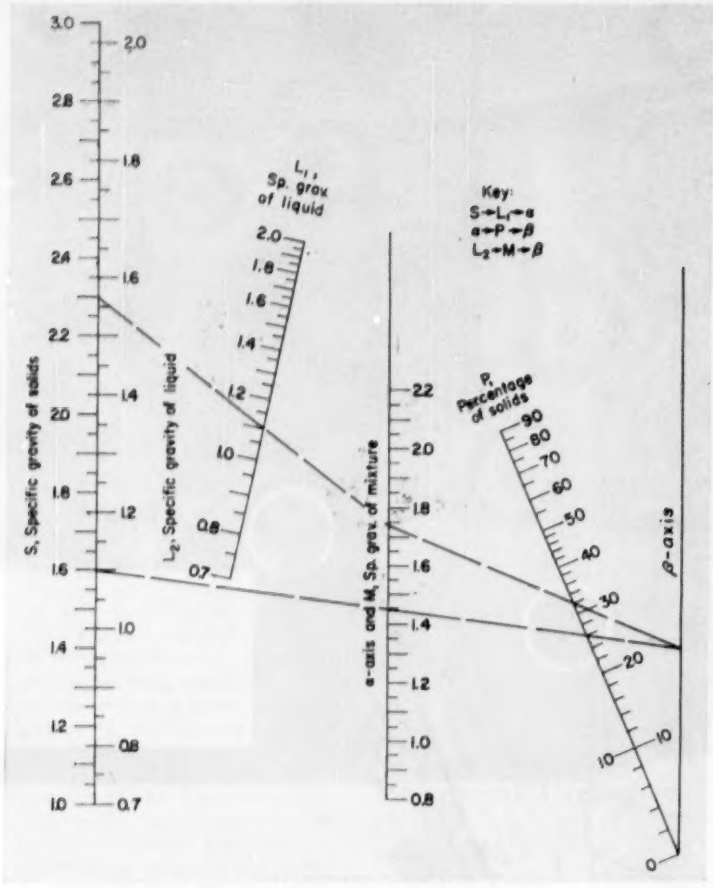


Chart Gives Gravities of Suspensions

D. S. Davis
Head, Dept. of Pulp & Paper Technology, University of Alabama
Tuscaloosa, Ala.

The chart above is a nomographic representation of Cook's method (R. S. Cook, *Chem. Eng.*, **60**, 233, Mar. 1953) for calculating the approximate specific gravity of a mixture of solids and a liquid.

It is based on the equation:

$$M = \frac{(S/L - 1)}{100} P + L$$

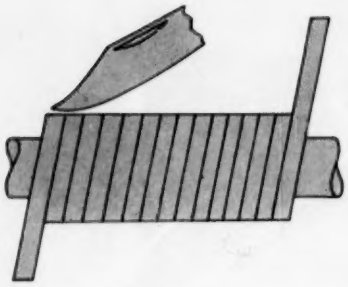
where M is the specific gravity of the mixture; S is the specific gravity of the solids; L is the specific gravity of the liquid; and P is the percentage of the solids in the mixture, by weight.

The chart was constructed by standard methods. Its use may be illustrated by means of the following example:

What is the specific gravity of a mixture of solids and liquid when the gravities of these components are 2.30 and 1.10 respectively, and the mixture contains 32% solids by weight?

Following the key, connect 2.30 on the S-scale and 1.10 on the slant L_1-scale with a straight line, marking the intersection with the alpha-axis. Connect this point with 32% solids on the P-scale and mark the intersection with the beta-axis.

Finally, connect the point on the beta-axis with 1.10 on the vertical L_2-scale and read the desired specific gravity of the mixture as 1.45 on the M-scale. Note that the alpha-axis and the M-scale both share the same position.



Accurate Way to Cut Spiral Packing Rings

Paul C. Ziemke
Engineer, Clinton, Tenn.

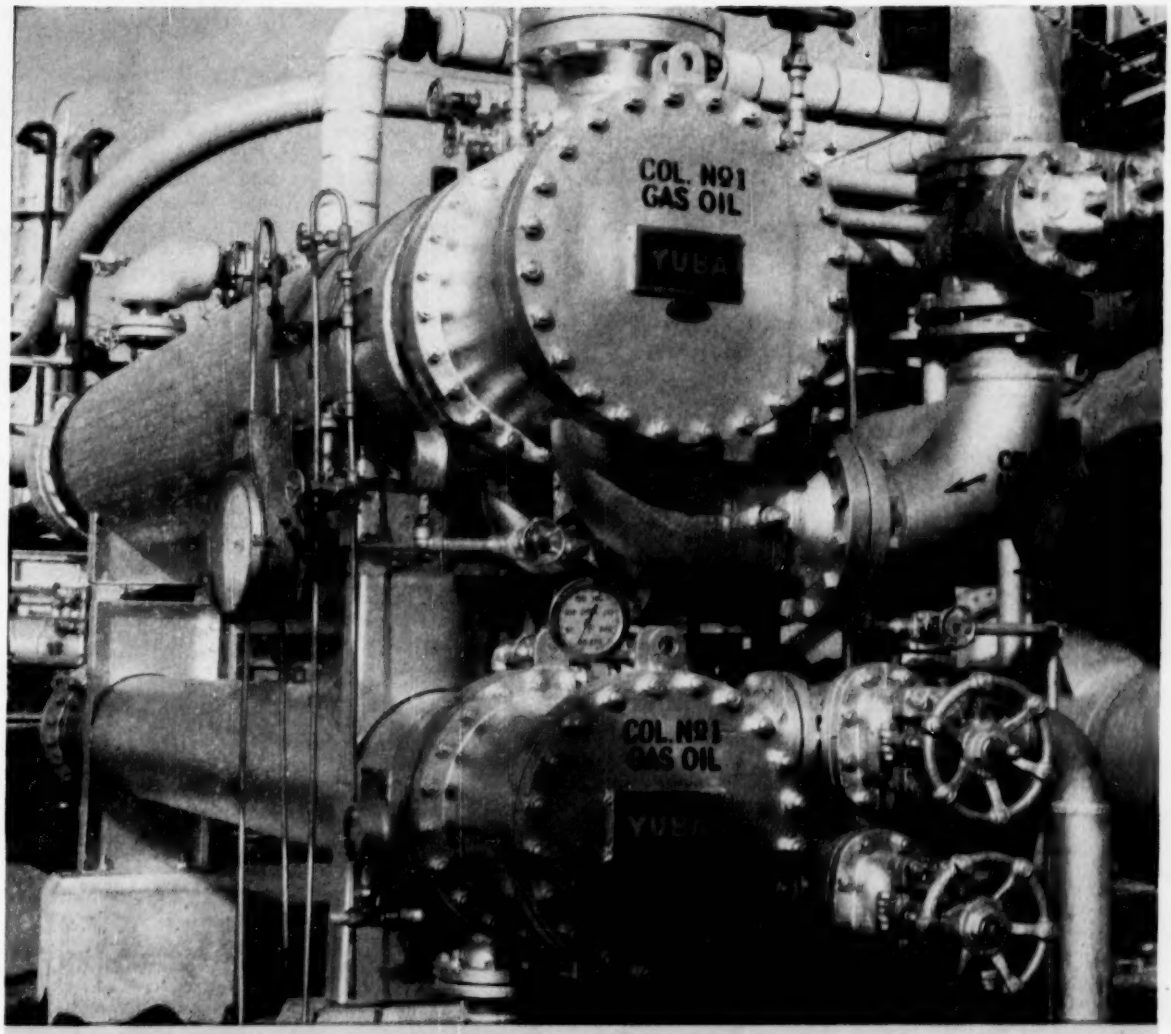
Cutting packing rings to insure proper diameter and perfect fit for use on gage glasses, glass pipe joints, and even for piston rods, pump shafts and valve stems, can be a vexing job. A little ingenuity is necessary to make sure that they are cut to exactly the right internal measurement.

Place a rod of the proper diameter in a vise and carefully wrap it with the required number of turns of packing material. Make sure that all the turns cling snugly to the rod and to each other. Otherwise, if any slack develops, the resulting rings will be useless.

One can secure the ends of the packing to the rod in several ways. One is to drive a small nail in the ends to secure them to the work bench. Another is to use electrician's tape.

When this is finished, use an old razor blade or a sharp knife to cut the packing carefully along the center line of the rod, making the cut about half way through. Then remove the rod to free the turns and separate the links.

The small amount of stretch developed by the original tension applied as the material was wound on the rod will have resulted in just the right size of



WHAT YUBA MEANS BY ENGINEERED HEAT EXCHANGERS

The manufacturer of heat exchangers is the sales engineer who services your account...the design engineer who designs the equipment and selects the materials...the welding engineer who specifies the welding procedures...the quality control engineer who sees that incoming materials meet specifications . . . that top-quality work is performed at every stage of manufacture...and the production control engineer who schedules your order so it will arrive the day you need it.

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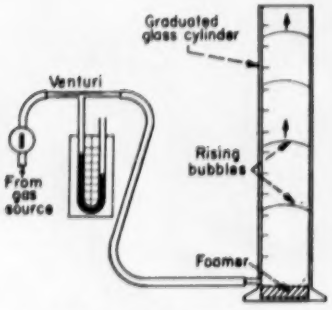
California Steel Products Division, Richmond, Calif.
Adsco Division, Buffalo, N. Y.

gap between the ring ends when the final cut is made before placing the packing in the gland.

This plan works best with the smaller packings because they can readily be stretched taut on the rod. However, with additional care in the winding process it is also possible to cut larger packing materials successfully in this way.



Simple Calibration for Small Gas Meters

Dietrich Müller
Shawinigan Falls, Quebec, Canada.

The sketch above shows an easy way to get a direct volumetric measurement of gas flow for calibrating small gas flow meters.

Use a graduated glass cylinder with an inlet tube near the bottom and put a small amount of foamer, such as soap solution, in the bottom so that its level is just below the orifice of the inlet tube.

Connect the meter—a venturi, an orifice, a capillary or whatever type of meter is to be calibrated, so that the flow rate can be regulated by a valve or cock, while the meter discharges into the bottom of the cylinder. When starting the test, shake the cylinder a little to form bubbles which will then be carried upward by the gas flow.

The rising bubbles can easily be timed by means of a stop watch. Since the glass cylinder is graduated and its volume is known, it is easy by timing the bubbles to calculate the volume flow rate. For all practical purposes the bubbles can be considered weightless and without friction against the walls of the tube.

By changing the valve setting the meter can be calibrated at several flow rates. If the available equipment is too small, high flow rates can be extrapolated from the calibration graph.

Quick Conversion for Temperatures

George F. Hausenbauer
Chemical Engineer, Alco Products Inc., Schenectady, N. Y.

There are many methods for converting temperature from Fahrenheit to Centigrade, and vice versa, all of which stem back to the fact that 1.8 Fahrenheit degrees equals 1.0 Centigrade degree. Here is one system which I find especially easy to use without confusion.

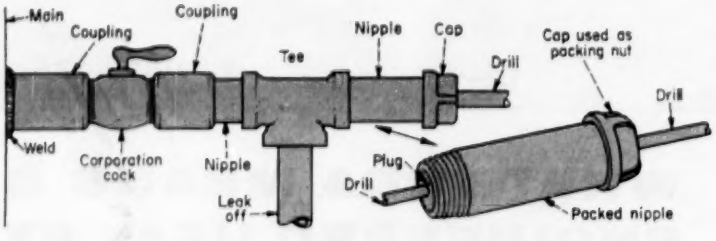
The temperature is first converted to absolute:

Deg. F. + 460 = deg. R.
Deg. C. + 273 = deg. K.

Then it is converted to the other system by multiplying or dividing by 1.8 as the case may be, after which the result is converted back from absolute to C. or F. by subtracting the appropriate value of 460 or 273. Thus only three numbers need be remembered—460, 273 and 1.8—and the fact that the zero points of the two scales do not coincide need not be taken into consideration.

The method will be clear from a couple of examples: Convert 60 F. to deg. C. First convert to absolute: 60 + 460 = 520 R. Divide by 1.8: 520 ÷ 1.8 = 289 K. Reconvert to Centigrade: 289 − 273 = 16 C. Perry's Handbook gives 15.6 C. as the correct value. This method can be made a little more accurate by using 459.4 as the addition factor for the F. to R. conversion, but usually this is not worthwhile.

Trying the reverse conversion: Convert 80 C. to deg. F. First, 80 + 273 = 353 K. Then, 353 × 1.8 = 635 R. Finally, 635 − 460 = 175 F. Perry's gives a more accurate value of 176 F.



Leakless Installation of Test Line

Buckley Sullivan
Engineer, Cleveland, Ohio.

When it is necessary to connect a test line to a water main or other liquid-carrying pipe without shutoff, here's a way that will do it leaklessly.

Cut and weld a coupling to the main, using two torches to get a sound weld if the main is very cold. Then attach a corporation cock, coupling, short nipple and tee with leakoff connection. End the train with a stuffing box for the extension drill made as shown in the sketch.

For the stuffing box plug one end of a short nipple, then bore a hole of drill size through the plug and through a separate pipe cap. Insert the drill and fill the nipple with packing, compressing it to a fairly leakless assembly by screwing down the cap.

Now, open the cock, insert the drill, tighten the cap and drill the hole. When this is done withdraw the drill, close the cock, remove the surplus fittings, and connect final piping.

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U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

Second U.S.I. Polyethylene Plant Planned for 1958

A second plant to produce U.S.I. PETROTHENE® polyethylene will be built at a new location by National Petro-Chemicals Corporation, majority owned and managed by U.S.I. and minority owned by Panhandle Eastern Pipeline Company.

The new plant, scheduled for operation by late 1958, will produce 75 million pounds-per-year of intermediate density polyethylene resins. Capacity of the present Tuscola, Illinois plant is 100 million pounds-per-year, making the Company's total projected capacity 175 million pounds-per-year.

A modification of the conventional high-pressure process, already proved in the Tuscola plant, will be used in the new installation. Resins produced there will be of an intermediate density type, with properties somewhere between those of the original polyethylenes with which the public is familiar, and the new high-density resins produced by so-called "low-pressure" processes.

Gulf Coast Under Consideration

Site for the new plant has not been chosen. Several Gulf Coast sites are under consideration and the Company has already optioned land at more than one location. The new plant will be constructed in a location other than Tuscola in order to assure customers of a continuing source of supply if production at either location were to be temporarily interrupted. Dual locations will also provide two separate shipping points for PETROTHENE resins, and permit even more rapid delivery to customers in some areas.

Engineering of the new plant has not waited for a final decision on location, however, and this phase of the project is already well underway. M. W. Kellogg Company is handling design and construction of the new plant.

National Petro-Chemicals is already the third largest polyethylene producer in the United States, despite its relatively short history in this field. Petro first entered the field in February, 1955 when its 26 million pound-per-year plant in Tuscola, Illinois came onstream. This was expanded in 1956 to 50 million pounds-per-year, and again in 1957 to 100 million pounds-per-year.

New Feed Supplement for Ruminants Made by U.S.I.

A new, patented liquid feed supplement for cattle and sheep, trademarked MOREA®, will be made by U.S.I. and marketed in most states east of the Mississippi and west of the Continental Divide. U.S.I. will operate under license from Feed Service Corp. of Crete, Nebraska, which developed the product. Feed Service Corp. has been test marketing MOREA in the Midwest for the past several years.

The new supplement accelerates rumen fermentation, enabling cattle and sheep to eat and digest more feed in a shorter time. Dairy animals show improved production. Beef cattle grow faster, produce a higher quality meat than cattle raised by other

MORE

TVA Pilot Plant Demonstrates Fertilizer Formulation with Wet Process Phosphoric Acid

High Analysis Ammonium Phosphate and Ammonium Phosphate-Nitrate Mixtures Can be Granulated Easily And Economically with Continuous Ammoniator

Pilot plant runs, conducted recently by TVA's Office of Chemical Engineering at Wilson Dam, Alabama, demonstrated new methods for making high analysis ammonium phosphate and ammonium phosphate-nitrate granular fertilizers such as 7-28-28, 17-17-17 and 15-15-15. About 400 members of the industry saw the 3-day demonstrations, in which a key role was assigned to wet process phosphoric acid.

Most of the demonstrations were carried out in TVA's continuous ammoniator, in some cases with auxiliary equipment. This type of ammoniator is simple and has found extensive use in industry. It can be employed to make a wide range of grades from a variety of raw materials, including phosphate rock, the superphosphates, and many of the materials produced by U.S.I.—wet process phosphoric acid, anhydrous ammonia, nitrogen solutions, ammonium nitrate, and sulfuric and nitric acids.

Wet process phosphoric acid was used in preparing all ammonium phosphate and ammonium phosphate-nitrate mixtures shown in the table below, which summarizes data published by TVA.

Granulation of a number of grades was accomplished better with wet process acid than with electric furnace acid. Excellent granulation in high nitrogen products was achieved with wet process acid, to which a small amount of iron ore form had been added.

Granules of the products were generally spherical and quite hard. Bag-storage and open bin bulk-storage test results were favorable.

Wet Process Acid Economical

Also of prime interest at the demonstrations were studies prepared by TVA indicating that high analysis granular mixtures made with wet process phosphoric acid may be produced at lower cost than conventional fertilizers. This was shown specifically for several grades, using raw materials costs believed typical for a midwestern location.

Other highlights of the demonstrations included manufacture of high analysis mixed goods using diammonium phosphate, superphosphoric acid, and electric furnace phosphoric acid; manufacture of nitric acid phosphates, granular normal superphosphate, granular triple superphosphate, granular enriched superphosphate, and granular no-nitrogen grades.

TVA FORMULATIONS FOR AMMONIUM PHOSPHATE, AND AMMONIUM PHOSPHATE-NITRATE FERTILIZERS UTILIZING WET PROCESS PHOSPHORIC ACID

Material	Grade	17-17-17	15-15-15	11-22-22	16-48-0	8-16-32	7-28-28
Phosphoric Acid, Wet Process	75% H_3PO_4	625	425	809	1767	589	1033
Ammoniating Solution *	—	826 (Z-7)	481 (Z-7)	541 (X)	242 (X)	382 (X-6)	—
Anhydrous Ammonia	—	—	—	—	275	—	173
Ammonium Sulfate	20.5% N	—	500	—	—	—	—
Sulfuric Acid	93% H_2SO_4	112	—	—	—	—	—
Potassium Chloride	60% K_2O	567	500	733	—	1067	933
Concentrated Superphosphate	46% P_2O_5	—	150	—	—	—	—
Iron Ore	—	—	—	—	—	20	—
Filler	—	—	—	51	—	—	—
Conditioner	—	44	53	80	88	84	52
Recycle	—	4500	2000	2500	7000	1500	2000

* COMPOSITION OF AMMONIATING SOLUTIONS, %

U.S.I. Designation	TVA Designation	Free Ammonia	Ammonium Nitrate	Ammonium Carbamate	Water	Total N
(1)	X	22.2	65.0	0	12.8	41.0
(10)	X-6	25.0	69.0	0	6.0	44.8
(2)	Y	26.2	55.5	0	18.3	41.0
(12)	Z-7	19.0	64.0	0	7.0	41.4

U.S.I. CHEMICAL NEWS

CONTINUED *Supplement*

feeding methods (more marbling with less waste fat).

MOREA is a liquid mixture containing urea, ethanol, phosphoric acid, essential trace minerals and molasses. U.S.I. will sell a concentrated liquid MOREA premix to feed manufacturers who will blend the concentrate with molasses. The company is currently appointing manufacturers who will mix and distribute the final MOREA product to feeders. U.S.I. is a basic producer of ethanol and phosphoric acid which are both in the premix.

X-rays Measure Hafnium In Zirconium Samples

Small amounts of hafnium in zirconium samples can be determined by means of X-ray fluorescence, according to two members of the Faculty of Science of Paris. After a sample is bombarded with X-rays, an aluminum monocrystal and a Geiger counter measure the intensity of the resulting characteristic spectrum of hafnium.

More precise measurements may be obtained by monitoring part of the beam from the X-ray tube with a tantalum sample and an auxiliary counter. A hafnium content of about 0.016% can be detected in this way.

Come to the "Atomfair"

The 1957 Trade Fair of the Atomic Industry is being held at the New York Coliseum from October 28-31. The Fair is being staged in conjunction with the Atomic Industrial Forum's annual atomic industry conference; the Winter meeting of the American Nuclear Society; the first major unclassified Reactor Safety Conference; the second conference on Careers in Nuclear Science & Engineering; and the annual meeting of the Professional Group on Nuclear Science of the Institute of Radio Engineers.

Look for U.S.I. in Booths 117-118.

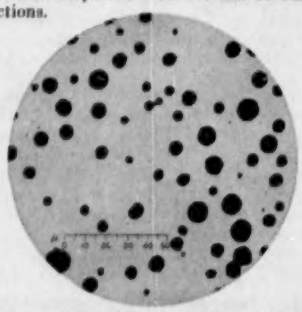
Sodium Dispersions May Be Key to Lower Cost Acetylacetone Production

The use of sodium dispersions as a catalyst for production of acetylacetone may permit substantial reductions in production costs, according to recently reported experimental work. Yields are higher, and reaction time much shorter, than with processes using sodium alkoxide or small pieces of metallic sodium. Also, the hazards involved in producing acetylacetone by the sodium alkoxide route are minimized when sodium dispersions are used.

In the experiments reported, sodium dispersions in toluene and xylene were added to mixtures of acetone and methyl acetate with the medium-boiling hydrocarbons as diluents. The dispersion samples used were obtained from U.S.I. The reaction was carefully controlled. Acetic acid and ethyl acetate were used to separate and extract the acetylacetone. On distillation under vacuum, a water-white, acid-free acetylacetone of 97 to 99% purity was obtained.

Total reaction time was about two hours, as compared with 24 hours with small pieces of sodium and 40 to 50 hours with sodium alkoxide.

A recently published 42 page booklet entitled "Sodium Dispersions" is available from U.S.I. to those interested in using sodium in dispersed form for this or similar reactions.



Photomicrograph of typical sodium dispersion, with most particles of 2-15 microns diameter.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U. S. I.

A new polyvinyl acetate resin emulsion adhesive, compatible with dextrine adhesives, is designed for high-speed case and carton sealing. Adhesives can be changed without shutting down machine to clean glue box. **No. 1281**

Proteins and amino acids in animal nutrition are discussed in detail in a revised, up-to-date booklet. Included are such subjects as Mutual Supplementary Action of Proteins; Relation of Amino Acid Requirements to Protein Level. **No. 1282**

Electronically heat-sealable vinyl gravure inks in a wide range of colors are currently being produced. Prints for automotive upholstery have been heat-sealed without destructive arcing sometimes found in conventional inks. **No. 1283**

An atomic reactor is being made with a polyethylene moderator. Can be used for applied research, radiation testing, a wide range of educational purposes -- such as training of reactor operators. Said to be versatile, inexpensive. **No. 1284**

A differential pressure liquid level transmitter mounted directly on a tank nozzle measures viscous or slurry-type liquids in open or closed vessels. It uses a force balance principle, can operate a remote indicator or recorder. **No. 1285**

A bright new B-O-N type red pigment has a bluish shade, good light and bleed resistance. Can be used alone or with other colors for a variety of shades. Said to be lower in cost, easier to grind. **No. 1286**

Polyethylene ware for laboratories and clinics is described in a new 8-page bulletin. Items available include beakers, aspirator bottles, tubing, pipet-fillers, vials, carboys. **No. 1287**

A new synthetic gum is said to be an excellent binder that dissolves in water or alcohol to give non-viscous solutions, even in high concentrations. Requires no preservative, being self-active as bactericide or germicide. **No. 1288**

A new hydrophobic lanolin derivative with good solubility and solubilizing properties is said to be valuable for aerosols, shampoos, suntan and sunscreen preparations, and powders and talcs. **No. 1289**

Fire extinguishers are described in a new buyers guide. Information is given on dimensions, discharge ranges, laboratory approvals and classifications, and other construction data for portable fire-protection equipment. **No. 1290**

PRODUCTS OF U.S.I.

INORGANIC CHEMICALS:

Sodium, Metallic: cast solid in tank cars, steel drums, pails; bricks in barrels, pails.
Chlorine: liquid, in tank cars.
Caustic Soda: 50% liquid, in tank cars.
Sodium Peroxide: dust-free granules, in drums.
Sodium Sulfate
Sulfuric Acid: all strengths, 60° Baumé to 40% Oleum. Also Electrolytic grade to Federal specifications. Tank cars or tank wagons.
Phosphatic Fertilizer Solution (Wet Process Phosphoric Acid)
Ammonia: Anhydrous, commercial and refrigeration. Tank cars or tank wagons.
Nitrogen Fertilizer Solutions
Ammonium Nitrate: 83%

OTHER PRODUCTS:

Alcohols: Ethyl (pure and all denatured formulas), Normal Butyl, Amyl, Fusel Oil; Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL® PR.

PETROTHENE® Polyethylene Resins.
Esters, Ethers and Ketones: Normal Butyl Acetate, Dibutyl Phthalate, Diethyl Carbonate, Diethyl Oxalate, Ethyl Acetate, Ethyl Ether, Acetone, Diatol®.
Intermediates and Fine Chemicals: Acetoacetarylides, Dimethyl Hydrazine, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Chloride, Ethyl Sodium Oxalacetate, U.S.I. ISOSEBACIC® Acid, Methyl Hydrazine, Sodium Ethylate Solution, Triethyl Aluminum, Trimethyl Aluminum, Urethan USP (Ethyl Carbamate).
Animal Feed Products: Calcium Pantothenate, Choline Chloride Products, Curbay B-G® 80, Special Liquid Curbay®, DL-Methionine, Niacin USP, Riboflavin Concentrates, Vitamin B_{12} and Antibiotic Feed Supplements, Vacetone® 40, Vitamin D_3 and K_3 Products, Antioxidant (BHT) Products, Special Mixes, U.S.I. Permadry Products (Sealed-In Vitamin A).
Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Riboflavin USP, Urethan USP, Intermediates.
Metals: Titanium Sponge, Zirconium Sponge, Zirconium Platelets, Hafnium Oxide, Hafnium Sponge.

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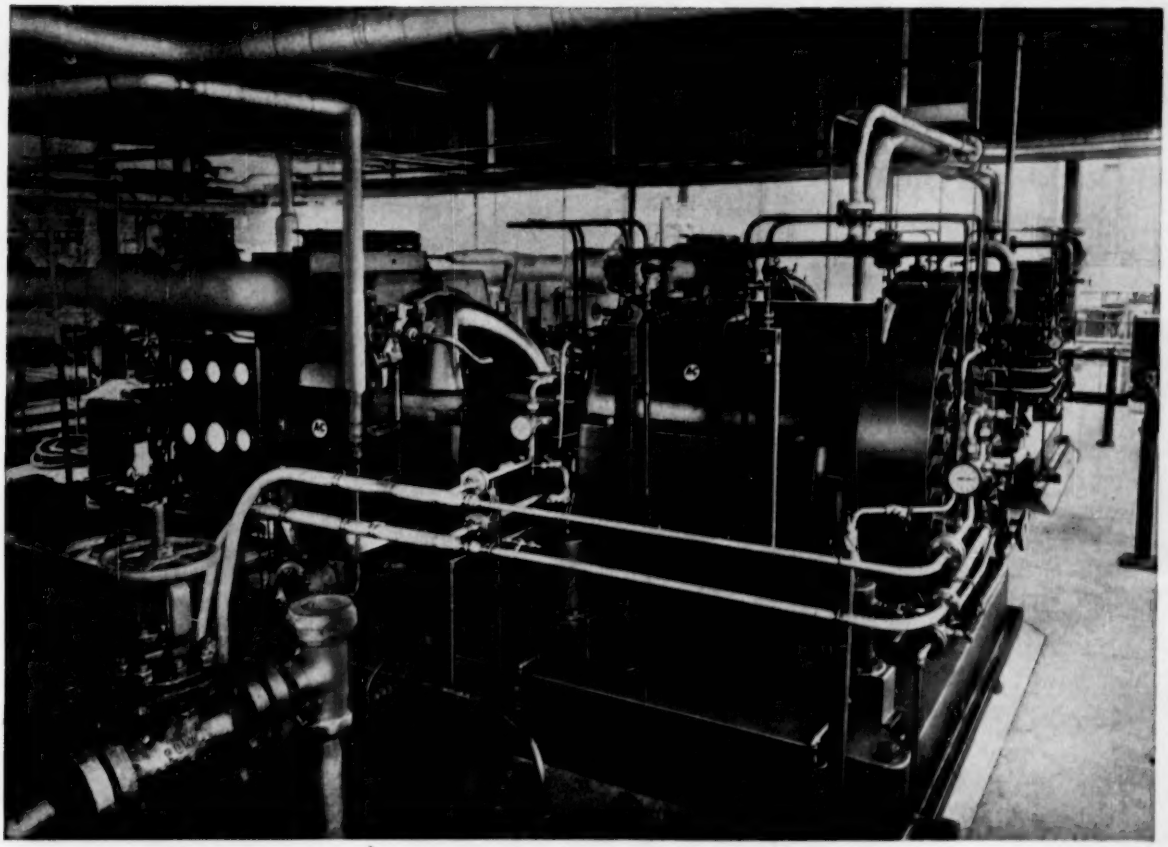


Engineered and constructed by The M. W. Kellogg Company.

Gulf Refinery Uses Allis-Chalmers Compressors for Hydrogen Recycling

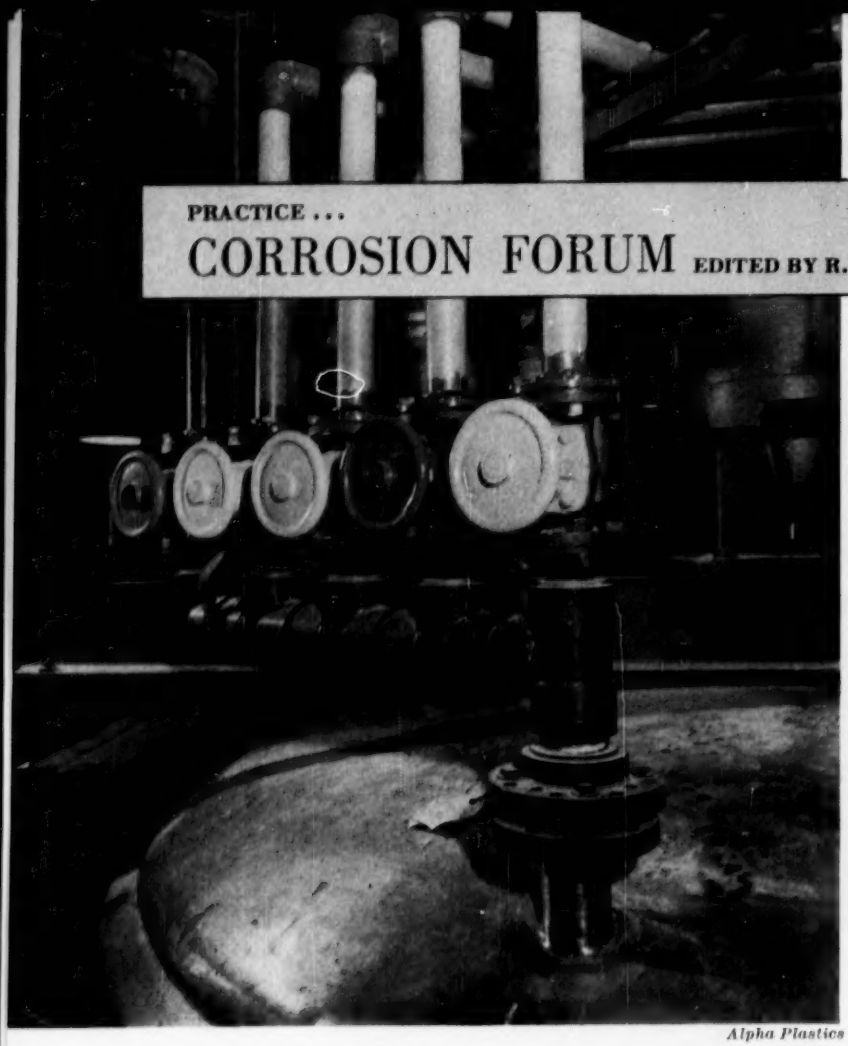
Two high pressure compressors of the latest Allis-Chalmers barrel-type design are in use at the Gulf Oil Corporation Plant at Port Arthur, Texas.

These units are used in a desulphurization process, in the refining of fuel oil. They are typical of Allis-Chalmers units chosen for upgrading processes.

Allis-Chalmers builds centrifugal, axial, and rotary sliding-vane type compressors for all refinery applications. Contact your nearby A-C office for information about your requirements, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5421



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CORROSION FORUM

EDITED BY R. B. NORDEN

PROCESS PIPING . . .

Plastics Vie With Metals

Get acquainted with thermoplastics as engineering materials. Many are the advantages they offer in process piping. But use only after you also know their limitations.

James P. Kelleher, Carpenter Steel, Union, N. J.*
C. L. Mantell, Newark College of Engineering, Newark, N. J.*

To an ever increasing degree plastics are attaining significant recognition as raw materials for the production of pipe and piping components.

No longer are they temporary substitutes for metals and alloys. Plastics are finding acceptance on their own merits, particularly for their unique and superior engineering properties.

The subject of plastics is a very broad one. We will limit our discussion here to those materials called thermoplastic—a very important group of plastics widely used in chemical process piping.

Thermoplastic pipe materials available now include cellulose acetate butyrate (Butyrate), polyethylene, polyvinylidene chloride (Saran), styrene copolymer (Kralastic) and polyvinyl chloride Type I and Type II.*

These materials offer advantages of corrosion resistance, light weight, low cost, ease of installation, self-insulating characteristics, low solids deposit tendencies, low frictional losses. They have, however, lower mechanical properties than metals, and these properties are severely changed by temperature.

Of all the plastic materials mentioned, the one generally believed to have the best combination of engineering properties is rigid, unplasticized polyvinyl chloride (PVC).

Variety of Sizes Available

Rigid PVC in both types can be made in a variety of tubular sizes by extrusion or by fabrication from sheet stock.

Similarly, fabricated fittings can be made available which are compatible with tubular shapes of large or unusual dimensions. However, for the purpose of this article, availability will mean standard pipe, fittings and valves in those sizes which represent major usage in the chemical process industry. These nominal pipe sizes are ½-in., ¾-in., 1-in., 1¼-in., 1½-in., 2-in., 3-in., 4-in., and 6-in.

Pipe in the above sizes is readily available in schedules 40, 80, 120, 160 and in several schedules lighter than 40. The most general availability is in schedules 40 and 80, and these will probably represent the greatest usage in the chemical process industry.

For fittings and valves see the tables for availability of the most common types in the sizes shown.

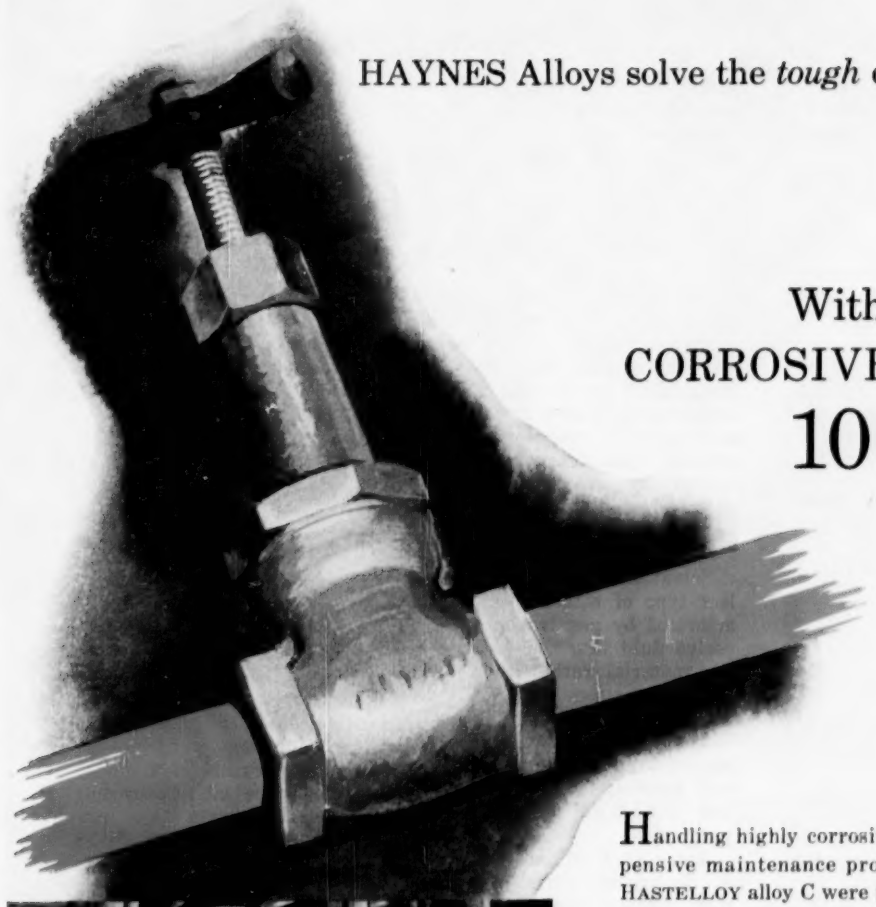
Corrosion Resistance Is Good

Plastic materials in general, and rigid polyvinyl chloride in particular, are not attacked in a manner similar to metals. Me-

*Meet your authors on pages 325 and 329.

*Type I is unplasticized PVC containing small amounts of internal lubricant, color, and stabilizer. Type II contains modifying resins and fillers to increase impact strength.

HAYNES Alloys solve the *tough* corrosion problems



Withstands CORROSIVE CHLORINE 10 years!

Handling highly corrosive liquid chlorine was an expensive maintenance problem—until valves made of HASTELLOY alloy C were installed. They are still in operation after 10 years of service and are expected to last indefinitely.

This is just one of the many corrosion difficulties met by HAYNES Alloys. They also have excellent resistance to hot mineral acids, strongly oxidizing salts, powerful gaseous oxidants, and combinations of these media over a wide range of temperatures and concentrations.

The booklet "HASTELLOY Corrosion-Resistant Alloys" describes these alloys that are solving corrosion problems in many industries—write for your copy. Haynes Stellite Company, Division of Union Carbide Corporation, General Offices and Works, Kokomo, Indiana.

. . . Handling Corrosive Liquids No Longer An Expensive Problem. The 30 valves in the chlorine pipe line required constant maintenance. Before valves made of HASTELLOY alloy C were installed, 3 to 4 of the thirty valves had to be replaced each week. Now . . . maintenance is simply periodic inspection and repacking.

HAYNES ALLOYS

HAYNES STELLITE COMPANY
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tallic corrosion is generally electrolytic in nature and rigid PVC is an nonconductor of electric current.

Corrosion of properly applied metals usually progresses at a fairly uniform rate and can generally be expressed quantitatively in terms of a penetration, such as inches per year. Except in a relatively few instances, the term "complete resistance" is not truly applicable.

However, with a plastic material, such as rigid PVC, we have what might be termed a "go or no-go" situation. Where it is resistant, it suffers no attack; where it is attacked, it is attacked severely.

There are two types of attack which may occur. One is direct chemical attack. This is the more uncommon type in which the surface of the material reacts chemically with the environment and is progressively destroyed. This attack is generally caused by strongly oxidizing chemicals and would more often be experienced with Type II PVC.

Solvation is the more prevalent type of attack. It is characterized by penetration of corrosive fluid into the interior of the material rather than by a surface reaction. Under such attack, rigid PVC shows a weight increase in direct proportion to accompanying volume increase and swelling. End result is a loss of physical and mechanical properties.

This kind of attack occurs in its worst form with certain classes of organic compounds, such as ketones, esters, ethers, aromatic hydrocarbons, and chlorinated hydrocarbons. Neither PVC Type I or PVC Type II is recommended for the handling of these compounds.

Actually, within the range of temperatures where PVC might have application, these compounds are easily handled by inexpensive metallic materials, and they, therefore, do not represent a fertile field for plastics.

Pipe & Fittings Available In Rigid PVC

(Std. iron pipe sizes ½, ¾, 1, 1¼, 1½, 2, 3, 4-in.)

Molded pipe

Molded fittings
- 90° elbows
- 45° elbows
- Cap
- Coupling
- Plug
- Union
- Pipe flange

Fabricated fittings
- All above in 6-in. size
- Expansion loop
- Nipples

Molded reducing fittings (Bushing, couplings, flanges except as noted)
- ¾ to ½ in.
- 1 to ½
- 1 to ¾
- 1¼ to ¾
- 1¼ to 1
- 1½ to ¾
- 1½ to 1
- 1½ to 1¼
- 2 to 1
- 2 to 1½
- 3 to 2 (fab. coupling)
- 4 to 2 (fab. coupling)
- 4 to 3 (fab. coupling)
- 6 to 4 (fab bushing)
- (fab. coupling)

Available Valves in Rigid PVC

	Iron Pipe Size, In.								
	½	¾	1	1¼	1½	2	3	4	6
Diaphragm	M	M	M	M	M	M	M	NA	NA
Y-globe	M	M	M	M	M	M	F	F	F
Plug	M	M	M	M	M	M	NA	NA	NA
Needle	F	NA	NA	NA	NA	NA	NA	NA	NA
Check	M	M	M	NA	M	F	F	F	F
Gate	NA	NA	NA	NA	NA	NA	NA	NA	NA

M = Molded fittings; F = Fabricated fittings; NA = Not available

PVC Type I offers excellent resistance to salt solutions, alkalies, non-oxidizing acids, and to many oxidizing acids. It also resists alcohols and many other types of organic compounds. It is one of the few plastic materials which effectively resists a large number of oxidizing chemicals.

Following is an indication of the ability of the Type I material to handle the most troublesome acids within its range of temperature applications:

Acid	Concentration
Hydrochloric	All
Hydrofluoric	All up to 50%
Sulphuric	All up to 98%
Nitric	All up to 68%
Phosphoric	All
Acetic	All up to 90%

As far as PVC Type II is concerned, the same general comments apply except that this grade is generally less resistant than PVC Type I in the handling of oxidizing solutions and, in other cases, a somewhat lower maximum temperature is recommended. Principle manufacturers of pipe or fittings publish tables and charts which provide a general guide to the suitability or non-suitability of both types of rigid PVC.

Flammability of PVC

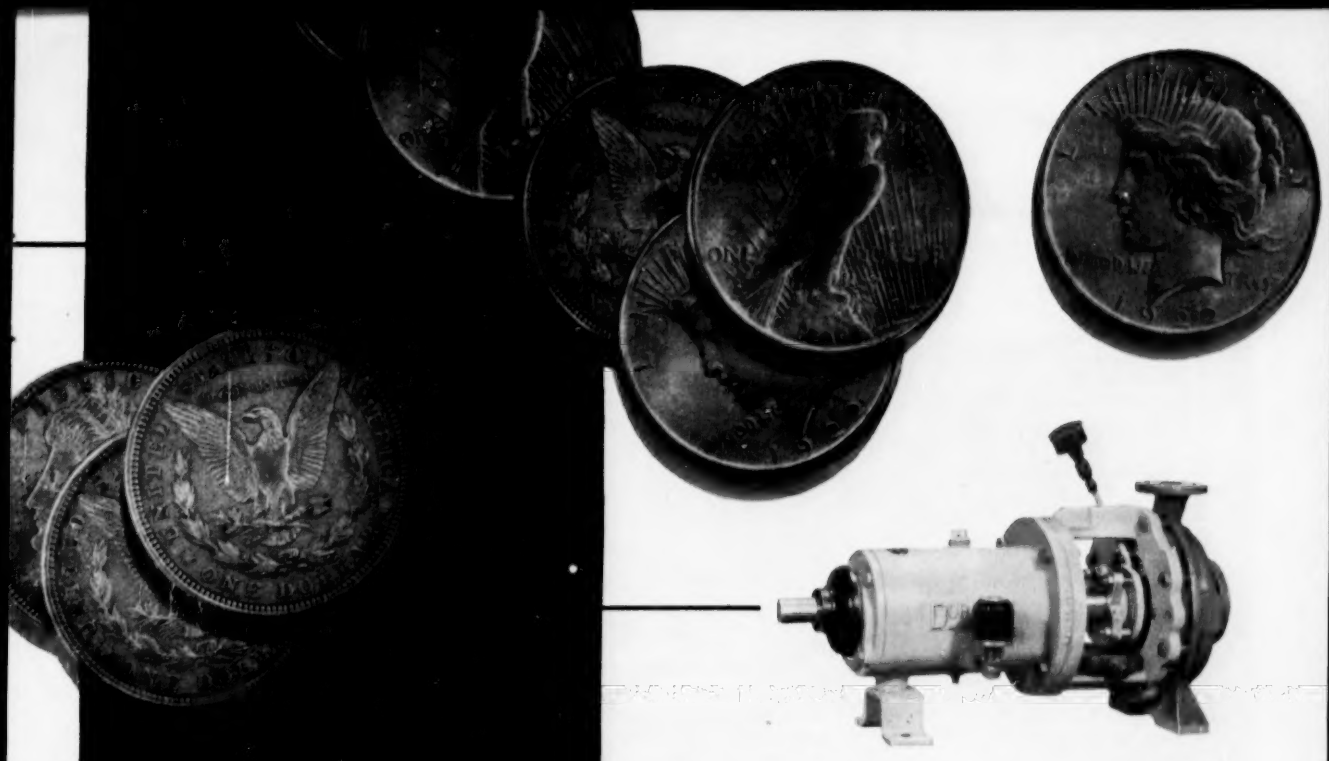
One of the objections often raised in connection with plastic piping is that most plastic materials—organic in nature—are to varying degrees, flammable materials. PVC Type I and PVC Type II are among the few plastic materials which are classified as self-extinguishing. This means these materials, when ignited, arrest further propagation of flame. The only other available thermoplastic piping material which exhibits this property is Saran.

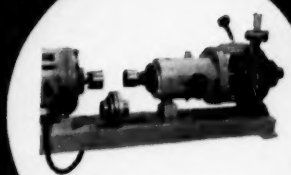
Weathering of PVC

Another objection raised with plastic piping concerns degradation, which can occur as a result of weathering, such as exposure to direct sunlight.

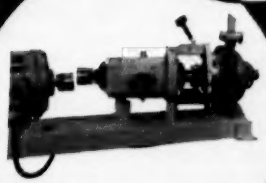
Degradation varies with the type of plastic, but in general, is evidenced by a loss in mechanical properties, particularly tensile strength and impact strength.

Under the sponsorship of one of the leading suppliers of PVC





1. Remove spacer from coupling.



2. Remove cap screws.

3. Remove the pump. Suction and discharge lines undisturbed, motor and alignment unaffected.

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Tensile Strength and Modulus of Elasticity for Important Materials

	Tensile Strength (Psi.)	Modulus of Elasticity (Psi.)	Reference
PVC Type I	8,000	415,000	3
PVC Type II	6,000	350,000	3
Polyethylene	2,800	20,000	3, 6
Butyrate	4,200	130,000	3
Styrene copolymer (Kralastic)	4,000	300,000	3
Vinylidene chloride (Saran)	5,000	100,000	3
Chemical lead	2,500	2,000,000	4
Aluminum (Alcoa 2S)	13,000	10,000,000	4
Copper	32,000	16,000,000	4
Carbon steel	60,000	30,000,000	4
Stainless Type 304	85,000	28,000,000	4

Type I and Type II extrusion and molding compounds,[2] a continuing program of testing has been undertaken to compare weathering of these materials with weathering of competitive thermoplastic piping materials.

After two years exposure to all types of weather Type I PVC maintained it's original tensile and impact strength, while Type II PVC, polyethylene, butyrate and styrene all had decreased tensile or impact strengths.

Mechanical and Physical Properties

Mechanical and physical properties of most plastic piping materials, as reported from various sources, are not readily comparable and vary over a fairly wide range.

Recognizing this problem, the Society of the Plastics Industry has sponsored a research project at Battelle Memorial Institute to provide firm design values for those properties required in the engineering application of piping. Meanwhile, the values presented here may be considered to represent a good consolidation of information available.

Information presented will, in certain pertinent cases, compare Type I and Type II PVC with principle competitive thermoplastics and with important metallics.

Tensile Strength Is High

Although unplasticized PVC does not possess the tensile strength of most common metallics, it compares favorably with other materials of its type and with a metallic such as chemical lead. This is illustrated in the table of nominal, room-temperature tensile strength values.

Effect of Temperature—Thermoplastic in nature, Type I PVC and Type II will soften and become less strong as temperature is increased. Effect of temperature is quite pronounced within the general range of usability: from 10 F. to 150 F. with Type I and from 0 F. to 130 F. with Type II.

The following relationships[4] are useful in estimating the short-time tensile strength of these materials at a given temperature within their range of usability.

$S = 10{,}310 - 43.9\ t$ (Type I)

$S = 8{,}690 - 39.5\ t$ (Type II)

Where S = tensile strength (psi.) and t = temperature (F.)

Effect of Time—As with other materials, stress required for rupture is a function of time as well as temperature. This same behavior is associated with metals. But, with the exception of lead, the tendency to cold flow or creep is much less significant at ordinary temperatures.

Although the designer of steel structures or components need not concern himself with this factor, except for high temperature service, he must be very aware of it with plastics even at room temperature.

Unfortunately, data and relationships have not been developed to a degree which will permit prediction of the long-term stress resistance of PVC Type I or PVC Type II at a given temperature.

However, the Society of the Plastics Industry and the basic raw materials producers, converters, and fabricators are sponsoring a research program at Battelle Memorial Institute to further develop such information. In the interim, a common practice has been to estimate the long term working tensile strength as one-fifth of the short-time tensile strength.

PVC More Rigid

The modulus of elasticity property may be considered as a measure of stiffness or rigidity. Materials with a modulus below 25,000 psi. may be considered flexible and the borderline between semi-rigid and rigid is approximately 200,000 psi.

The table presents nominal, room-temperature moduli for materials of interest. Note that Types I and II PVC are more rigid than comparable plastic materials but much less rigid than the common metallic materials.

Compressive and Flexural Strength

Compressive and flexural strengths are measures of the loads which are required to cause failure by compression or bending, respectively. Short-time room-temperature values of these properties are as follows:[5]

	Compressive Strength (Psi.)	Flexural Strength (Psi.)
PVC Type I	9,600	14,500
PVC Type II	8,000	11,500

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Used as oil coolers, each heat exchanger has a horizontal bank of 5/8" OD Bridgeport Steel/Copper Duplex Tubes. Before Bridgeport Duplex Tubes were installed, low-carbon steel tubes were used with disappointing results. Maximum service life of the steel tubes was two years, with some failures occurring after two months' service. *With Bridgeport Duplex Tubes installed, average in-service life was ten years.*

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This case emphasizes how Bridgeport Duplex Tubes provide a dependable, economical answer to dual corrosion problems. For full information on Duplex and standard condenser tubes, call your nearest Bridgeport Sales Office today.

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Working Pressures for Rigid PVC Piping at 75 F.

Extra Strong Schedule 80

Nominal Size, In.	Outside Diameter, In.	Wall Thickness, In.	Type I		Type II	
			Plain	Threaded	Plain	Threaded
½	0.840	0.147	575 psi.	330 psi.	470 psi.	270 psi.
¾	1.050	0.154	470	285	385	230
1	1.315	0.179	437	255	355	205
1¼	1.660	0.191	360	220	295	180
1½	1.900	0.200	325	205	265	170
2	2.375	0.218	280	190	230	155
3	3.400	0.300	260	170	215	140
4	4.500	0.337	225	160	185	130
6	6.625	0.432	195	150	160	125

Standard Schedule 40

Nominal Size, In.	Outside Diameter, In.	Wall Thickness, In.	Type I (Threading not recommended)	Type II
½	0.840	0.109	410 psi.	335 psi.
¾	1.050	0.113	335	275
1	1.315	0.133	310	255
1¼	1.660	0.140	255	210
1½	1.900	0.145	230	190
2	2.375	0.154	195	160
3	3.500	0.216	185	150
4	4.500	0.237	155	130
6	6.625	0.280	125	105

The short-time values of these strengths are in a fixed ratio to tensile strength. Since they are greater than tensile strength, and compressive loading is generally uneffective, fractures and cracks will usually occur in cross-sections under tension.

Heat Distortion Temperature

Heat distortion temperature (F.) at a stress of 264 psi. (ASTM D-648), is a statement of the temperature required to permit an arbitrary standard amount of deflection by a standard load, in a test in which the specimen is subjected to a gradually increasing temperature. It is thus an indication of the ability of a material to retain its stiffness, or resistance to deformation against the weakening influences of high temperature. The following table presents this properly for several thermoplastics of commercial interest available in the form of piping:

	Heat Distortion °F., 264 Psi.
PVC Type I	165
PVC Type II	155
Polyethylene	125
Butyrate	140
Kralastic	175
Saran	160

Temp. Conversion Factors

To calculate maximum working pressure at a temperature other than 75 F., above working pressures at 75 F. may be multiplied by the following factors:

Temperature °F.	Type I PVC Factor	Type II PVC Factor
0	1.47	1.52
10	1.41	1.45
20	1.34	1.38
40	1.22	1.24
60	1.09	1.11
80	0.97	0.97
100	0.84	0.83
120	0.72	0.47
130	0.65	0.27
140	0.59	....
160	0.53	....

Izod Impact Strength Is Important

The Izod impact strength in foot-pounds per inch of notch is the energy required to break a notched test bar by means of a sharp blow, and is thus an indication of the shock resistance, or conversely the notch-sensitivity, of the material.

The following table presents this property at room temperature for several thermoplastics of commercial interest in the form of piping.

	Izod Impact Strength Ft. Lbs. Per In. Notch	Reference
PVC Type I	0.8	3
PVC Type II	15.0	3
Polyethylene	32.0	8
Butyrate	3.0	3
Kralastic	5.0	3
Saran	0.3	3

Importance of this property is related to the manner in which the material is handled in fabrication, installation, and service. For example, it would be unwise to install a PVC Type I piping system with threaded joints in a system involving vibration, without special provisions to absorb this vibration. However, the use of a joining technique other than threading might permit the use of this material without any difficulty.

As might be expected the impact strengths of both types of PVC decrease with decreasing temperatures as shown by the following values in foot-pounds per inch of notch:

	−40F.	−32F.	78F.
PVC Type I	0.3	0.4	0.8
PVC Type II	0.9	3.8	15.0

(*Continued* p. 304)

CORROSION'S FOCAL POINTS are easy to detect with a new Amercoat testing method using iron and caustic indicators in a saline gelatin bath. On the welded and scored steel panels shown above after test, unworked surface areas turned red to indicate cathodic properties; but the weld, scores and edges turned blue (here shown blackened) to reveal themselves as anodic corrosion breeders. Rivets, threads, crevices and abrasions also show anodic under test. Unless such areas are effectively sealed from moisture, oxygen and ions they will erupt as focal points of corrosion cells.

How to protect "trouble spots" against corrosion

Ask a corrosion engineer where metal corrosion is likely to attack first. Chances are that he will name rivets, threads, sharp edges, angles, crevices and welds. These are the areas of stress concentration, work hardness, fissures and abrasions. They tend to be anodic and actually breed corrosion. And although they warrant increased protection, conventional coatings pull away from their sharp profiles and leave them inadequately covered.

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No. 87 combines the time-tested chemical and weather resistance of vinyl coatings with the thickness of mastic, yet it is easily sprayed with standard equipment over a suitable primer. Available in white, gray, black and aluminum. Use it for enduring protection at lower cost per square foot per year. Complete details mailed on request.—Amercoat Corp., South Gate, Calif.

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Comparing Costs of Piping Materials

	Cost/Ft.	
	½ in.	1½ in.
PVC I or II (Sch. 40)	$0.31	$0.81
PVC I or II (Sch. 80)	0.37	1.06
Carbon steel (Sch. 40)	0.10	0.29
Galvanized iron (Sch. 40)	0.12	0.36
Aluminum (Sch. 40)	0.24	0.70
Wrought iron (Sch. 40)	0.21	0.59
Lead-AA (Sch. 40)	0.75	2.25
Red brass (Sch. 40)	0.64	1.87
Stainless Type 304 (Sch. 40)	1.52	3.89
Monel (Sch. 40)	1.72	4.68
Stainless Type 316 (Sch. 40)	1.96	5.28

Allowable Working Pressures

The table of working pressures (p. 302) presents the maximum working pressures (psi.) which should be employed with PVC Type I and II at 75 F.

Specific Gravity

PVC Type I and PVC Type II are slightly heavier than most of the commercial thermoplastic piping materials with which they compete, but they are considerably lighter in weight than common metallics.

This is illustrated by the following table:

	Specific Gravity	Reference
PVC Type I	1.38	3
PVC Type II	1.35	3
Polyethylene	0.96	3
Butyrate	1.20	3
Kralastic	1.06	3
Saran	1.70	3
Chemical lead	11.35	4
Aluminum	2.71	4
Copper	8.92	4
Carbon steel	7.86	4
Stainless Type 304	8.02	4

This light weight of PVC, in common with the other plastics, could mean easier handling, lighter structural supports and in general, more economical installation costs than might be generally experienced with metallic piping.

Poor Thermal Conductor

In common with other plastic material, PVC Type I and PVC Type II are poor conductors of heat, with respect to common metallic piping materials. This is illustrated by the following table:

	Thermal Conductivity Btu/Sq. Ft./ Hr./F./In.	Reference
PVC Type I	1.3	
PVC Type II	1.6	
Chemical lead	240	4
Aluminum	1,540	4
Copper	2,700	4
Carbon steel	360	4
Stainless Type 304	113	4

This property might limit consideration of PVC for efficient heat-transfer equipment, but it might also permit the elimination of insulation when handling warm fluids. In addition, evidence is available which indicates that PVC piping is less susceptible to external condensation or "sweating", when handling chilled fluids.

Coefficient of Thermal Expansion

The expansion property represents magnitude of change in dimensions for a given change of temperature. PVC Type I and PVC Type II have expansion properties in the same order of magnitude as other commercial thermoplastic piping materials, but vary considerably from the common metallics:

	Coefficient of Expansion In./In./F.x10	Reference
PVC Type I	28	
PVC Type II	56	
Chemical lead	16.4	4
Aluminum	12.9	4
Copper	9.3	4
Carbon steel	6.7	4
Stainless Type 304	9.6	4

Since such a high expansion rate could have distinct bearing on a piping system, methods of compensation are required in installing the pipe to allow for and support this expansion.

Smooth Surface Conditions

Both PVC Type I and Type II, in common with the competitive thermoplastic piping materials, have smooth surfaces.

In a piping system, this means that resistance to fluid flow is low; and, being unaffected by corrosion, the surface tends to remain smooth, with no increase in resistance to flow over extended periods of time. In addition, materials deposited from the transported fluid are less likely to cling to the smooth surface, thus minimizing the possibilities of scaling and clogging.

The following table presents mean rate of flow (gpm.) for a pressure drop of 15 psi. per 100 ft. of pipe in various sizes of scaled steel and rigid PVC schedule 40 standard piping:[9]

Nominal Size, In.	Steel	Rigid PVC
1	18	25
1¼	37	52
1½	56	78
2	108	150

Let's Compare Costs

Since cost will undoubtedly enter into the picture in many instances, let's consider this factor. The cost table presents the cost per ft. for 1,000 ft. lengths.

It should be pointed out that the above can only serve as a rough guide to comparative costs, since it does not include all of the elements of a piping system, such as, fittings, valves, adequate supports, insulation (which may be required with metals but not with PVC).

It also does not include installation labor, which could be in favor of metals in a case of threaded joints and personnel unfamiliar with plastics; or, could be greatly in favor of PVC with solvent-cemented joints and trained personnel.

As with the selection of other materials or equipment the proper and most economical choice will result from a proper engineering evaluation of the problem.

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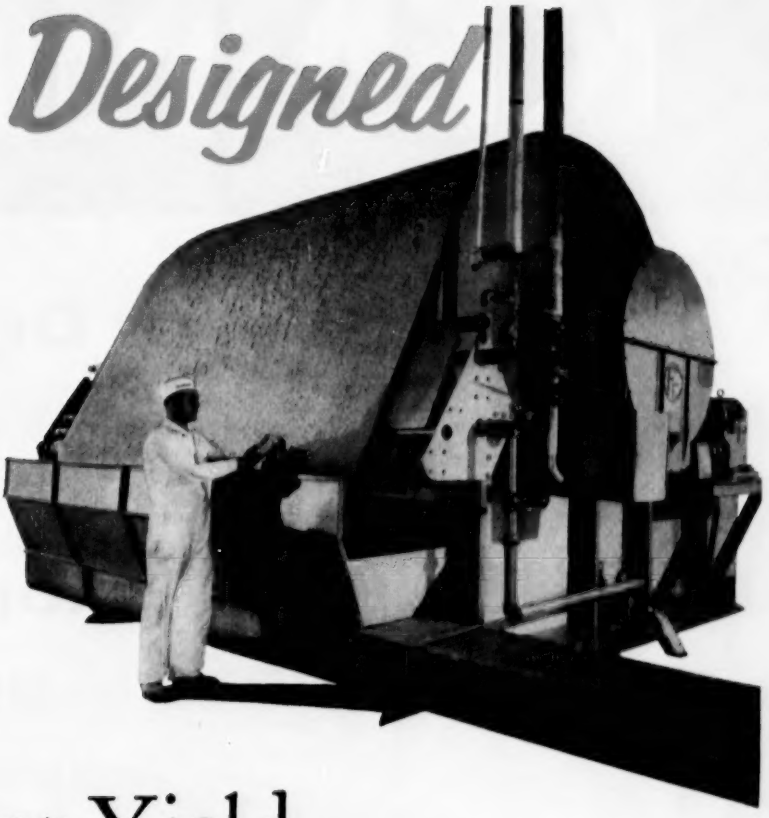

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- Eliminated plugging, gave three hours more running time daily on sticky clay
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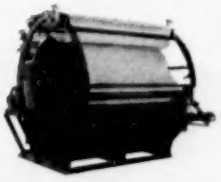

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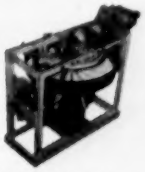

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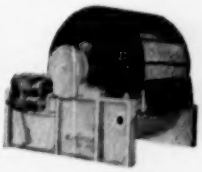

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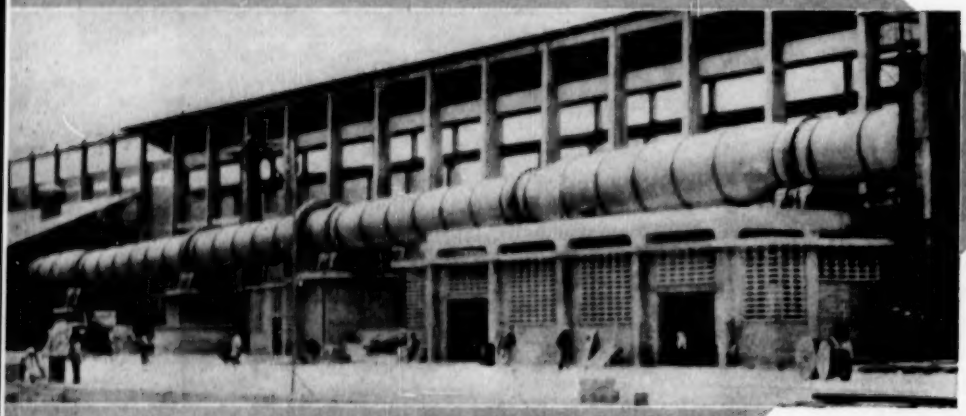
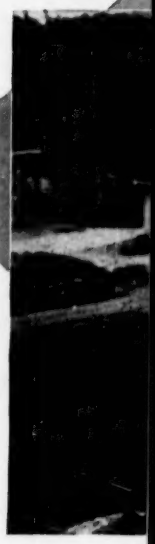


Kennedy 9' x 11'x350' Rotary Kiln being installed in Wet Process Cement Plant.



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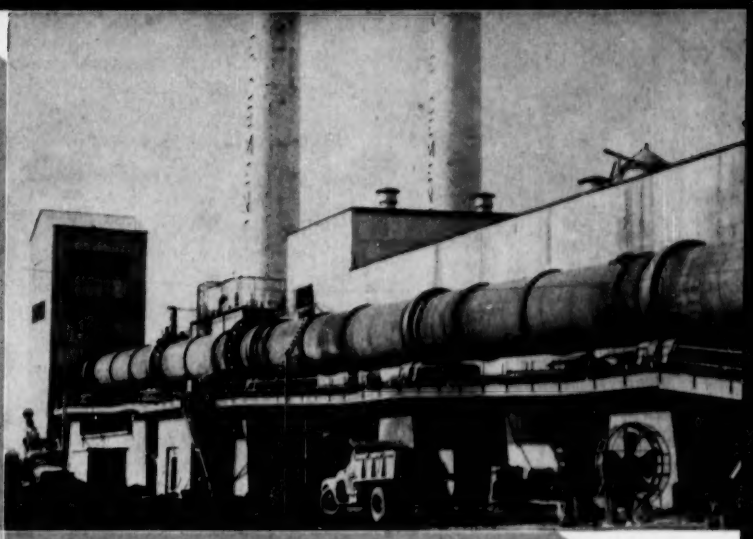
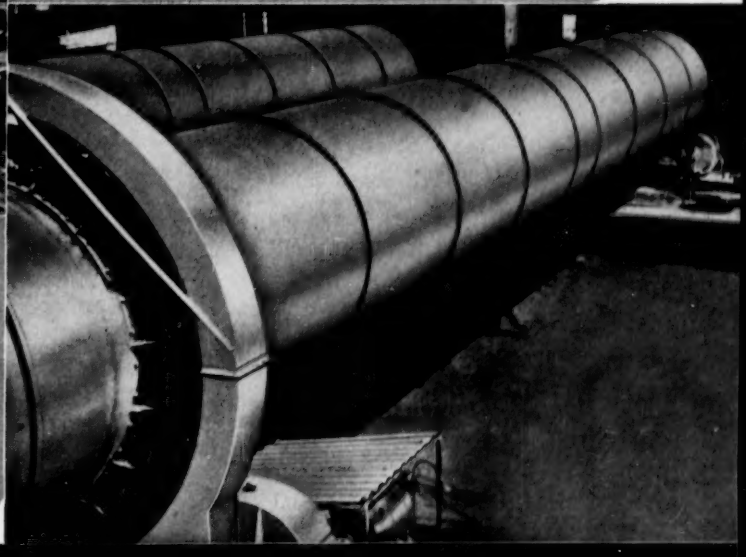


Kennedy, 11'x375' Rotary Kiln in Wet Process Plant.

Two, 10'x175' Kennedy Rotary Kilns, in Dry Process Cement Plant.



Two, 11'x375' Kennedy Rotary Kilns in process of erection at 5,000 Barrels per day. Wet process Cement Plant.

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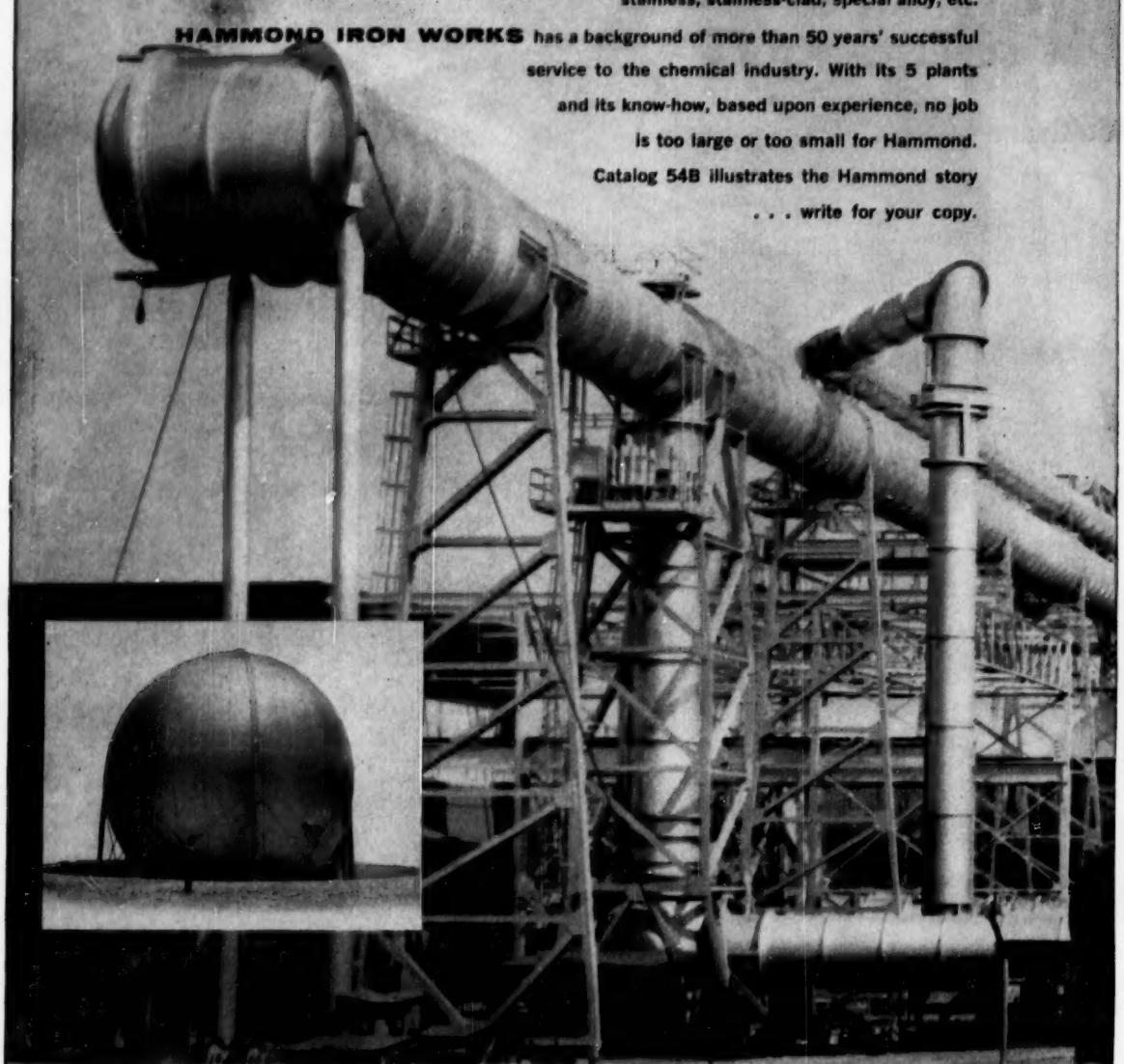

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Chemical Engineering

People

OCTOBER 1957

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How Much Is Special Training Worth?

- ☐ If your employer sent you to a specialized school for a full year at your full salary, would you expect to be earning more than other engineers at your experience level?
- ☐ Would you expect to get a salary increase when you returned to your employer?
- ☐ How much of an increase would you expect?
- ☐ If you spent the time and effort required to become a licensed professional engineer, would you expect—throughout your working career—to earn more than engineers who did not?

Common sense tells us that there ought to be special pay to compensate for special engineering training. But two new surveys say it isn't so.

THERE are many aspects to the problem of keeping up with the Joneses.

To some of us it means a pink Cadillac, a black Imperial with white-wall tires, or a four-bedroom split-level house in suburbia or built-in hi-fi equipment. This is the American way of life.

And American business is sometimes obsessed by the same sort of social urges.

"Let's set up an operations research team. It's the thing to do today."

"We ought to have a job-rotation plan for executive development."

"A company of our size should have its own high-speed computer."

"We must get into the nuclear field, somehow."

Each of these social pressures can influence the economic strategy of administrative planning. It's still a bit early for anyone to analyze the dollar-and-cents effect of social conformity (as exemplified above) on the well-being of the engineering profession and its employers.* But it's easy to make some long-range predictions, such as:

- Some engineers will learn to speak the language of operations research, increasing their professional potential.
- Job rotation will make for a less monotonous existence and sweeten the curse of some routine engineering jobs.
- ABC's of computers becomes a must subject for all engineers.
- Some engineers will be sent off to schools to peer into the middles of atoms.

What's It Worth?

In each of these instances, if the employer accedes to the urge to conform, some of his engineers will wind up with an accumulation of special knowledge.

It is not our function here to appraise the economic value of this special training to the employer (who foots the bill for it). This is a matter of individual company policy. Instead, we are more concerned with the increase in market value of the individual engineer with special training. Is it worthwhile for him to put in the extra effort that is often required?

What does it get him in the end?

What is special training worth in take-home pay?

An Exclusive Survey

Through the generosity of a close personal friend, *Chemical Engineering* has been given permission to publish some salary figures that, until now, were never available. These figures shed some light on one area of special training. It is a unique survey in one special area.

But if this survey is in any way indicative of the general situation, disillusionment will abound.

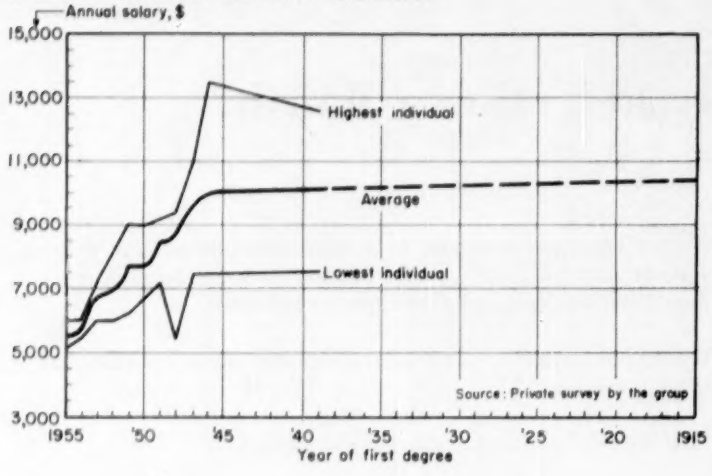
Meet a Select Group

Each September a group of about 100 gathers at Oak Ridge, Tenn. They have been selected

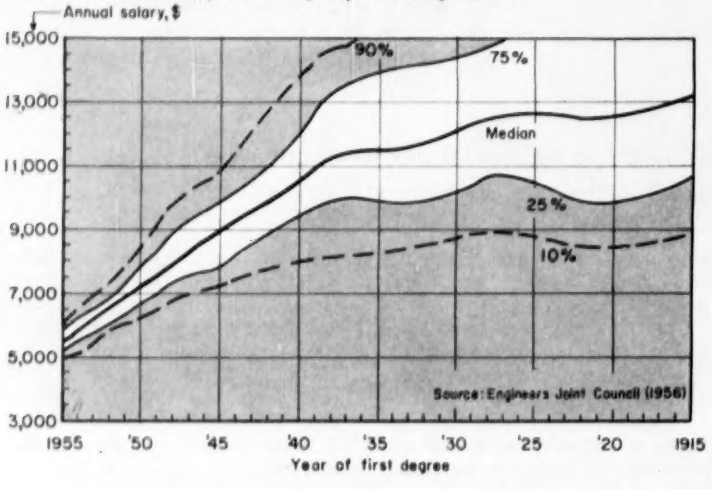
* For one excellent exception to our generalization see "Never Underestimate the Power of a Computer," by Ralph F. Lewis, *Harvard Business Review*, Sept.-Oct. 1957, pp. 77-84.

Comparing Three Salary Surveys

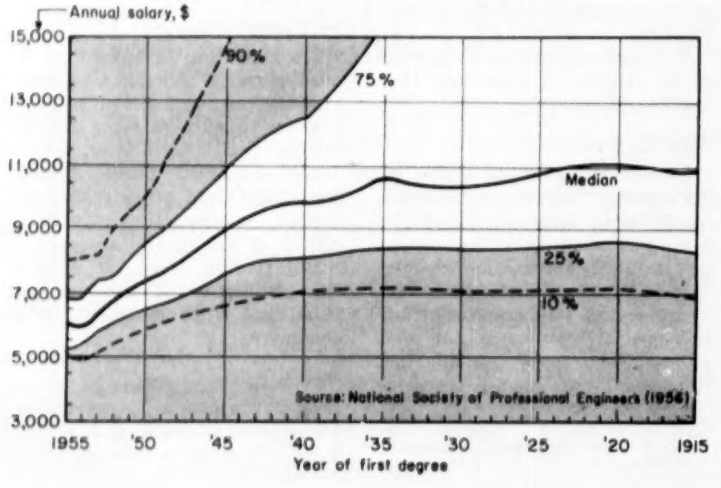
Salaries of the 1957 ORSORT Graduates



How Chemical Companies Pay 11,877 Engineers



17,045 Professional Engineers Report These Incomes



by their employers to enroll for a year of study at the Oak Ridge School of Reactor Technology (ORSORT). Many among the group are engineers. Many are married men who have been accompanied by their families to spend a full 12 months in the quiet surroundings of lakes, mountains, nuclear fission and eastern Tennessee.

The public schools in Oak Ridge are among the nation's finest. The shopping center is ultramodern. Although Oak Ridge itself can be considered a small town, the facilities of Knoxville are within comfortable driving distance.

Disturbing elements are the local-option laws that make this part of eastern Tennessee (and almost the entire state, now) a "dry" area; and the school-integration disturbances in Clinton, Tenn., a scant six miles away.

For Their Own Information

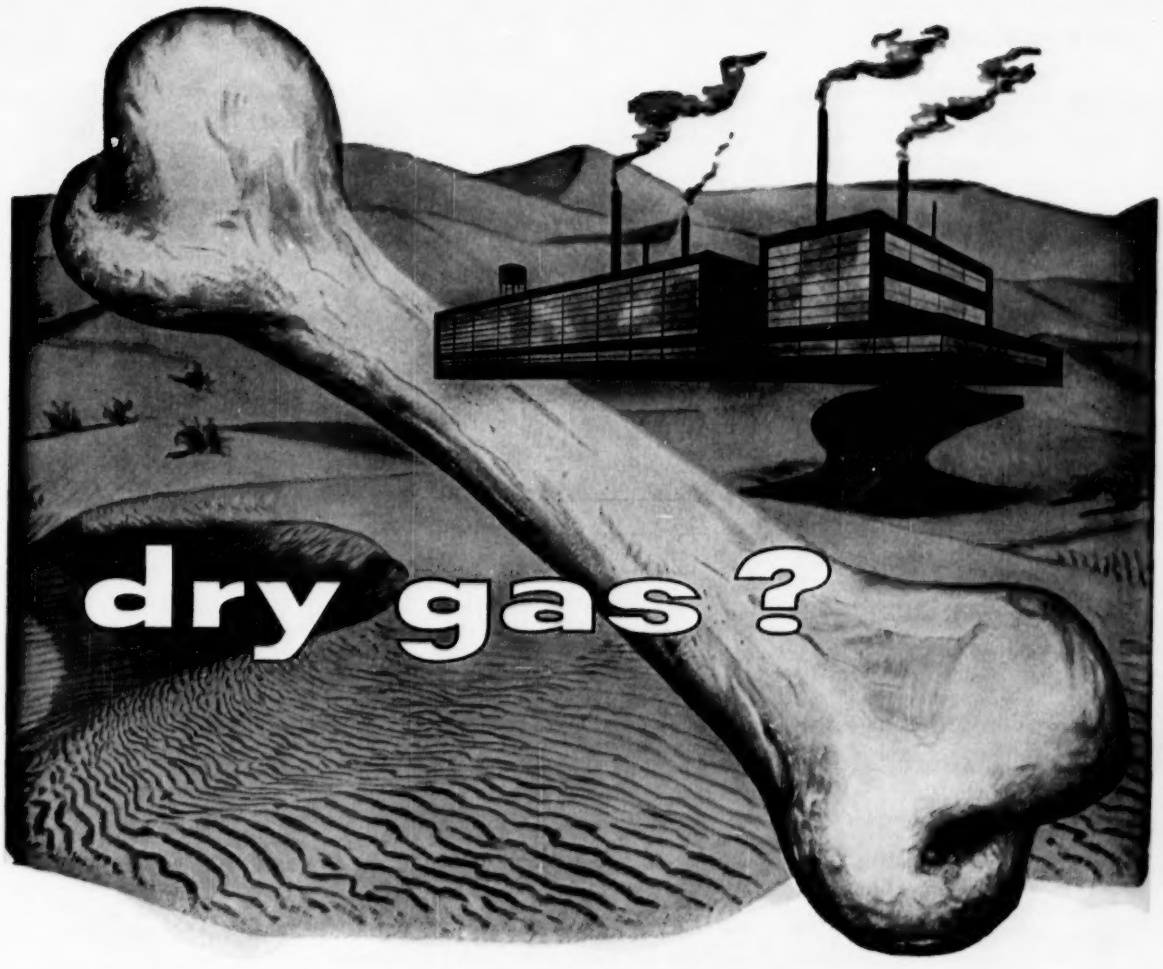
Throughout the fall and winter members of the group study at ORSORT on a full-time basis and at full salary from their employers. In the spring their fancies begin to turn to thoughts of what sort of job they'll have waiting for them when they report back to their employers in September—and at what salary?

Unofficially and among themselves, members of the 1957 class at ORSORT conducted a salary survey for their own personal information. 78 questionnaires—all unsigned—were returned out of 95 issued (an 82% return). In the group of 78, $1,122/month was the highest reported salary; $433/month was the lowest. Median salary was $631/month and $657 the average.

The group averaged 6.6 years of engineering experience when polled, with a median of 5.5 years; and the high man had accumulated 20 years of engineering experience.

Asked to report their nuclear experience exclusively, the group said that it had been in the nuclear field an average of 2.2 years and a median of 1.5 years. Longest in the nuclear field was one respondent with 7.7 years of experience.

We've shown the results of this survey graphically as the first figure. Annual salary is



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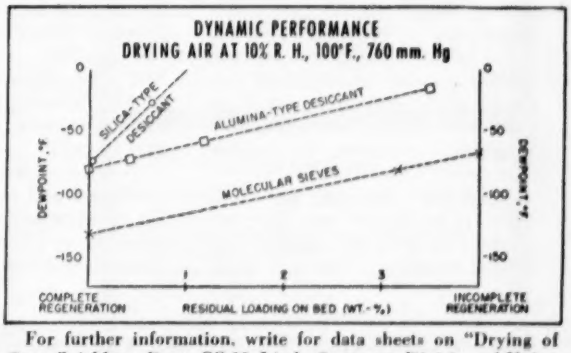
Even though your gas stream may already be partly dried, Molecular Sieves will remove the last traces of moisture. Only a small volume of adsorbent is required. The same combination of high capacity and low dew-point is also obtained at high temperatures, up to 200°F.

This is SUPER-drying! Dynamic performance is shown in the accompanying graph. This superior performance also can be expected at higher relative humidities and at other temperatures and pressures. Of particular significance in production is the relative insensitivity of Molecular Sieves to incomplete regeneration.



For further information, write for data sheets on "Drying of Gases." Address Dept. CG-10, Linde Company, Division of Union Carbide Corporation, 30 East 42nd St., New York 17, N. Y.

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plotted vs. year of first degree.

Two points on the chart are hard to believe. One respondent with 10 years of engineering experience reports an annual salary of $13,500. He seems to be a bit high-priced for his classmates. Then there's the fellow with 8 years of experience at a salary of $450/month. This point is unbelievable and possibly in error. Probably, it would be best to omit this point from the chart.

Looking at the average line, each point here represents the average for a number of individuals with equal experience. The 10-year point is actually for a group with 9-11 years of experience; and the 17-year point is for a 14- to 20-year-experience lumped group.

How Well Are They Doing?

All ORSORT students, of course, have been carefully selected by their employers. So these salary figures must be considered to be for a "select" group of individuals.

How well is this select group doing salarywise?

For comparison we have taken the results of the Engineers Joint Council salary survey completed late in 1956 and analyzed in *Chem. Eng.*, May 1957, p. 313. EJC reports median salaries rather than average, and this makes a direct comparison somewhat difficult. But by comparing Figs. 1 and 2 on the previous page it becomes apparent that the individuals selected for special training at ORSORT are not presently earning much more than what the chemical industry in general is paying its regular engineers.

Certainly we can say that there is no special pay just because you may be selected for special training. The next question, then, is how much would you be worth if you completed this special training.

Some Expect Nothing

As a marker buoy for future sailing, the ORSORT questionnaire asked respondents if they expected a salary increase when they returned to their employers. If so, how much?

Surprisingly, as many as 19% of the respondents expect no salary increase at all when they return to their employers. Another 19% replied that they just didn't know. The remaining 62% expect an increase.

Highest expected increases are $200/month, $167/month and $115/month. Average expected increase—including those who don't expect one—is $51/month (8% of the average salary); average expected increase—excluding those who expect no increase at all—is $67/month (11% of the average salary).

So there we have it. The average expected added value of special training is a 1-year increase of less than 10% of the average salary. It makes one wonder whether it is worthwhile to be a "select" engineer.

Pay for Professional Engineers

About the same time that we were given the ORSORT study, the National Society of Professional Engineers (NSPE) released their 1956 "Professional Engineers' Income and Salary Survey." Accompanying the survey booklet (available from NSPE headquarters, 2029 K St., N. W., Washington 6, D. C., at $1/copy), was a news release that began:

"Young engineers, chemical engineers and engineers in education have achieved the largest gains in total earnings over the period 1952-1956 and . . ."

Naturally, we were encouraged to read the survey very carefully. The survey is the third in a series started by NSPE in 1952. This 1956 edition is based on an analysis of 17,000 questionnaires returned from registered professional engineers in all branches of engineering. Questionnaires were mailed to 40,000 members of NSPE in January of this year and by the cut-off date in March, 46% of the questionnaires had been returned. Because of insufficient data and other pertinent reasons 3% were not used, giving a net usable return of 43%.

We have reproduced the results of this survey as the third chart on p. 312.

Use With Caution

However, we can not print the results of this survey without this note of caution. Because of the nature of NSPE (membership is restricted to engineers who are registered under the laws of the states and territories to practice as professional engineers) and the fact that most chemical engineers do not qualify for membership, less than 3.5% of the replies used in this survey are from chemical engineers.

Therefore, any sweeping generalizations about how well chemical engineers seem to be doing salarywise are based on rather scant data. With this preface, here's what NSPE concludes from their survey:

"Chemical engineers had a median earning total of $11,000 for 1956. Civil engineers had the lowest median earnings of any of the major branches with a figure of $8,750. Other median earning figures for 1956 were: electrical, $9,460; mechanical, $9,780; mining and metallurgical, $10,000."

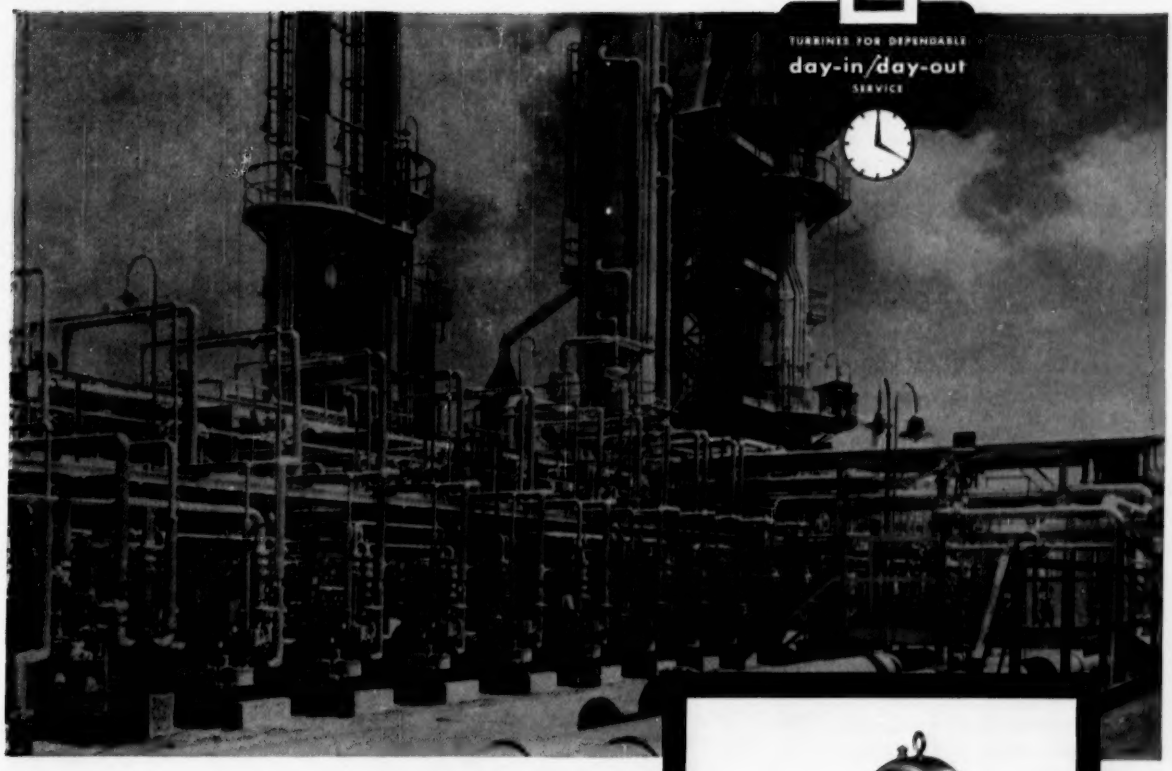
Does Special Training Pay?

What has the NSPE survey to do with the ORSORT survey?

The thing that ties them together is that professional engineers are also engineers with special training. And the question that came to mind was whether professional engineers earn more, throughout their careers, than engineers who do

Next Month: Should You Take That Overseas Job?

Be an engineer and you can see the world. For the youngster just starting out, this might be a persuasive inducement. Work overseas for a while and you won't have to pay income taxes. This might be an inducement for the engineer of any age. In fact, you can bank most of your salary and accumulate a sizable nest egg by the time you get back to the States. Take a job overseas and leave your problems behind you. Find romance, adventure, meet new people, see strange places. Next month an engineer with many years of working experience will let you share his first-hand knowledge of that overseas job.



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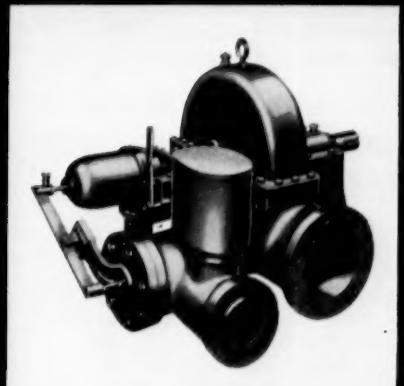

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not spend the time, effort and registration fees that are required to obtain and maintain a license. Does it pay to undergo this special training?

Unless we have misinterpreted these surveys, the general compression effect applies to all engineers. It seems that engineering has a median value to employers of about $10,000 per year per man; and this figure applies to engineers with or without special training.

A Plea for Common Sense

Someone once defined common sense this way:

"Common sense is nothing but the sum total of your accumulated prejudices."

Notwithstanding this definition, common sense would tell us that there ought to be special pay for special training. But these two new surveys tell us that it ain't necessarily so.

Undergoing the rigors of specialized training will not automatically guarantee a dollar return on the investment. The return must come from a combination of all of the various factors that contribute to professional success.

RECRUITING

. . . *Worries U. S. Chamber*

Following the lead of the ethical practices committee of the American Society for Engineering Education (see *Chem. Eng.*, July 1957, p. 307), the Chamber of Commerce of the United States and the College Placement Council, Inc., have issued broad proposals to protect college students from high-pressure job-recruiting tactics.

The proposals are in the new publication "Principles and Practices of College Recruiting," available from the Chamber in Washington, D. C. Briefly, here are the highlights of the recommendations:

- Colleges should provide competent counseling services, available to individual students, as a part of their general responsibility for development of the student.
- Information provided to students concerning an employer should be strictly factual. The student should be given a clear understanding of the requirements of his employment and that advancement will depend on ability and effort.
- No special bonuses or similar financial incentives should be given to influence a student's consideration of an employer's offer.
- Acceptance of an employment offer by the student should be made in good faith and with the sincere intention of honoring his employment commitment.

The Chamber points out that in addition to safeguarding students, the proposals would protect many employers who have refused to high-pressure youngsters they seek to hire.

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. . . *Development Course*

For the first time, the American Management Assn. is offering a course designed to train first-line supervision in the principles and practices of management.

Given in three one-week units, the course is designed for new appointees as well as for experienced supervisors who need a foundation in modern management techniques.

If you are interested in such a course for either yourself or your foremen, further details may be obtained from AMA.

SHOULD YOUR CHILD

. . . *Be an Engineer?*

How can you tell if your child would make a good engineer? That is, if you want your children to follow in your footsteps in the first place.

If you do, you can find some clues to your child's probable success as an engineer in an analysis prepared by T. Keith Glennan, president of Case Institute of Technology and made up into booklet form as a public service advertisement for the New York Life Insurance Co.

Copies of the booklet are available without charge by writing the public relations dept. of New York Life.

OIL AND SOAP

. . . *Step Up School Aid*

Timed for the opening of the fall semester, three of our largest corporations have announced increased aid to educational institutions:

- As one of several activities marking the 75th anniversary of Standard Oil Company (N.J.), the Esso Education Foundation will distribute a grant of $1.5 million to finance a special three-year program for stimulating education in science and engineering. Purpose of the program is to give a needed update to scientific and engineering education and, as a result, to interest greater numbers of promising students in these fields.
- Procter & Gamble is increasing its aid-to-education program to nearly $1 million annually with the announcement of a new plan of long-term, unrestricted grants to ten leading "national" universities and to the 39 state and regional associations of smaller independent colleges. The ten universities, which will each receive $20,000 annually, are those that "over the years have grown to become national rather than local and are widely recognized for their emphasis on excellence in scholarship." Chosen by P&G are: Chicago, Columbia, Cornell, Harvard, MIT, Northwestern, Pennsylvania, Princeton, Stanford and Yale.
- Gulf Oil Corp. announces a new six-fold program which increases Gulf's aid to colleges and universities by about $250,000/yr. Some estimates indicate that this will make it possible for Gulf to earmark as much as $1 million/yr. for aid to education under qualifications of the new plan and previous programs. A unique feature of the new Gulf plan is called "faculty salary supplementation." Each year the company will select and employ 15 college teachers as summer consultants paying them from $1,000 to $2,000 each. Recipients will be selected among teachers of subjects which are of interest to the company so that mutual benefits can be shared.

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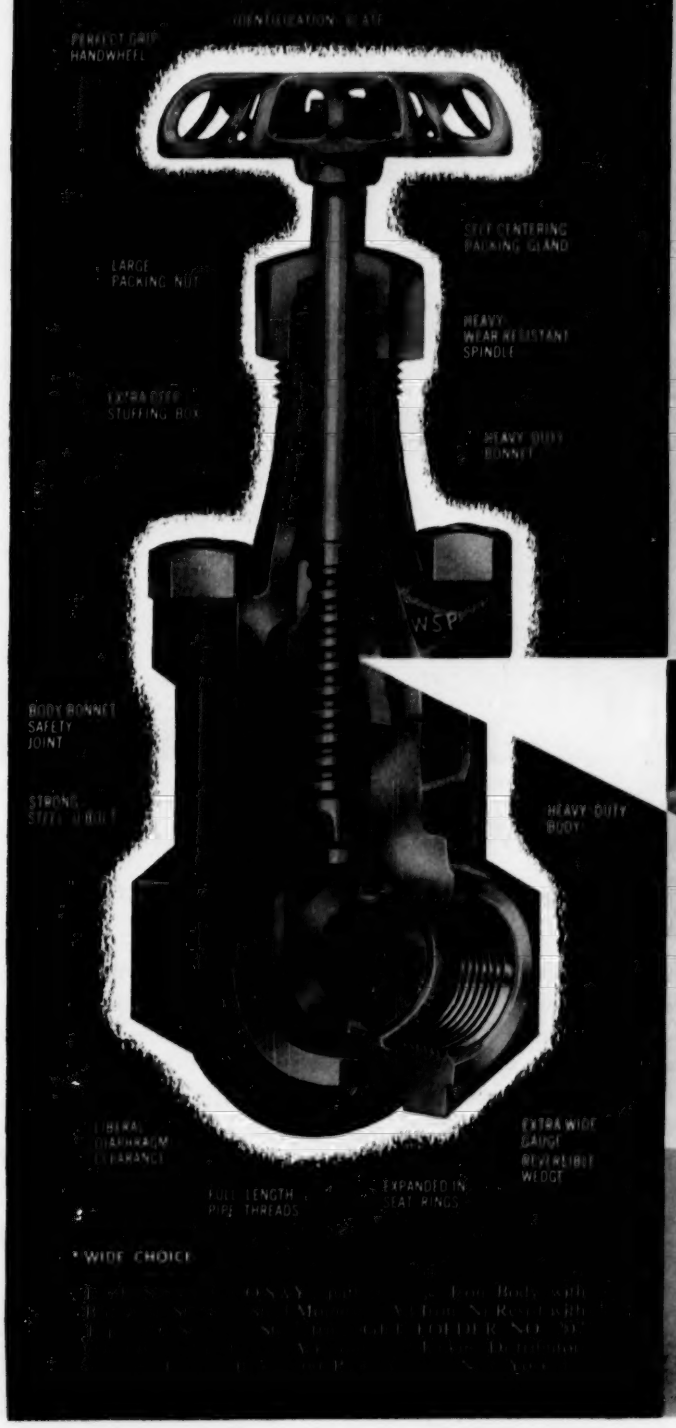

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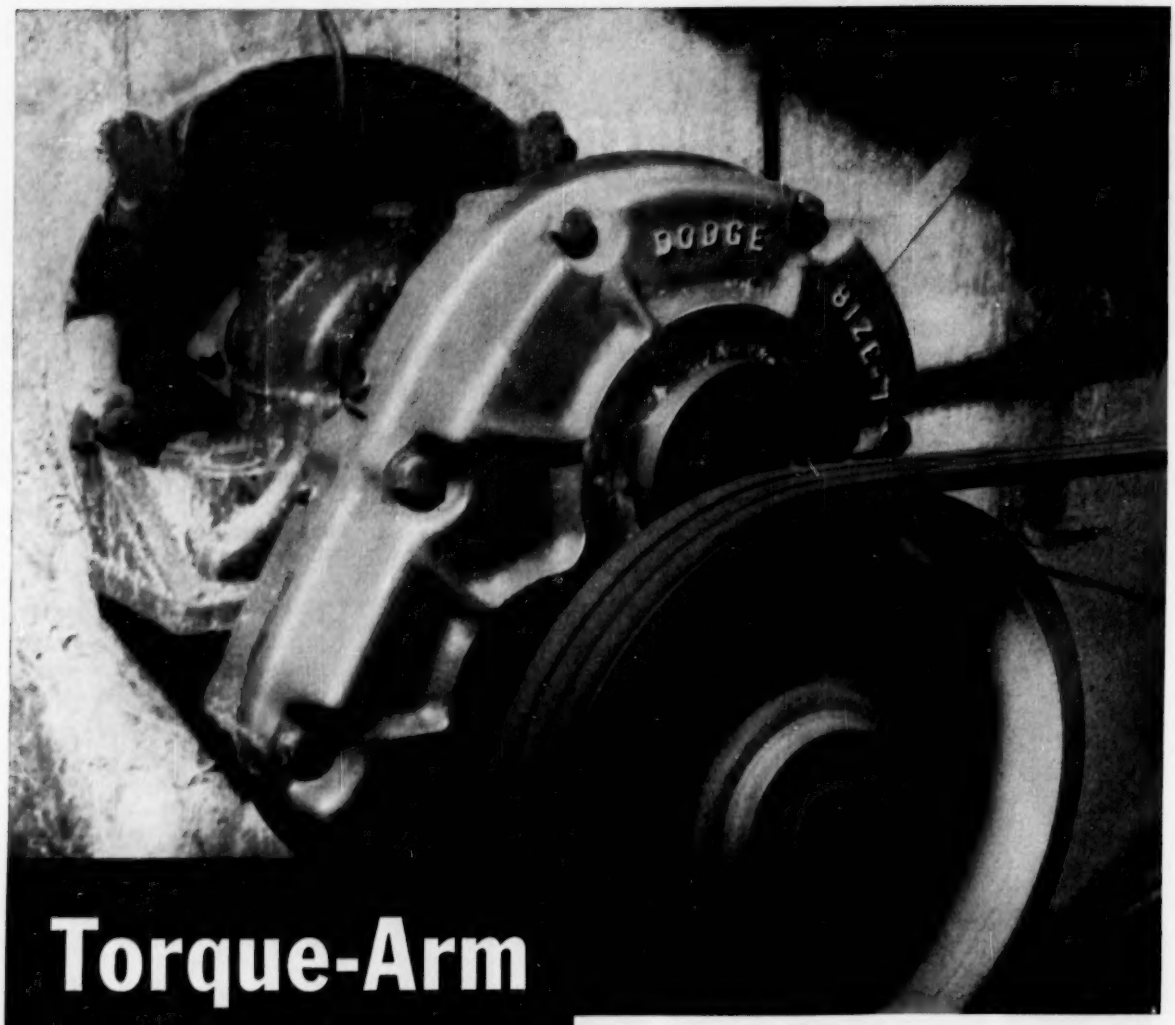

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Successful QC

QUALITY CONTROL AND STATISTICAL METHODS. By Edward M. Schrock. Reinhold Publishing Corp., New York. 246 pages. $6.75.
Reviewed by H. O. Hehner

Statistical quality control has grown steadily since the days of World War II.

Mechanical industry, because of the nature and evaluation of its products, developed and utilized these techniques earlier than did the chemical industry.

However, since "the need for quality control began when man first wanted to duplicate an object," statistical quality control is becoming as essential to operations in the chemical plant as is the very analytical laboratory in which control tests are made. Nonetheless, we have not yet reached the day that these procedures are an *ipso facto* part of all chemical production operations.

Schrock, one of the pioneers in the field in this country, recognizes the importance of proper organization for statistical quality control in his elementary book on the subject. He quite properly starts the book with some of the benefits to be derived from such a program and the methods of organization.

Any successful program requires, first—effective leadership, second—a comprehensive survey of quality losses, and third—proper evaluation of the factors that contribute to the greatest losses so that these can be studied first. A timetable and a method for measuring progress should also be established.

Obviously, statistical methods are not in themselves sufficient to make a quality program successful. Quality improvement can be measured in many ways, but it can usually be best understood by all when savings are expressed directly in dollars.

Having developed the idea of need for quality control and the benefits to be derived, Schrock leads into an elementary explanation of the basis of statistical quality control. He does this in plain language with very little of the theory behind statistical methods or probability. There are no derivations.

He gives a good explanation of the terms used and speaks briefly about summarizing and pictorially presenting data. Details are given for establishing and using various kinds of control charts. Acceptance samplings discussed at some length, but the treatment is very brief on sequential analysis, least squares and correlation, analysis of variance and significance tests.

The book is strictly concerned with quality control and not with design of experiment or other statistical applications. Since it is quite brief (less than 200 pages if QC tables are omitted), it is by no means as comprehensive as other recognized texts and references. The examples are from the mechanical industry but the principles can be adapted to use in the chemical and process industries.

The book is intended for people new to statistical quality control and seems considerably better suited to industrial people than to students by the very nature of its presentation.

Solvent Extraction

SOLVENT EXTRACTION IN ANALYTICAL EXTRACTION. By George H. Morrison and Henry Freiser. John Wiley & Sons, New York. 269 pages. $6.75.

This is a timely work, perhaps especially so from the viewpoint of many chemical engineers.

Prodded by demands of extractive metallurgy (zirconium, hafnium, thorium, uranium, rare earths), solvent extraction techniques have been hustled out of the lab and into the pilot plant. Techniques and data in this field are chronicled in widely scattered literature, and now we have a

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book that fills the need for a clear, up-to-date, comprehensive treatment of this important subject.

So while the book may be addressed to analytical chemists, the chemical engineer will find it an excellant companion to Treybal's "Liquid Extraction."

The first part of the book discusses principles of solvent extraction, formation of metal complexes (including chelate and ion-association) and qualitative and quantitative aspects of extraction equilibria.

Second part treats methods and techniques of extraction. Particularly interesting is a discussion of masking (sequestering) and salting-out agents.

The remaining 253 pages give a wealth of information on extraction systems (32 of them), procedures for extracting the elements and physical constants of organic solvents. There is no treatment of solvent extraction applied to separation of organic compounds in general.

This volume is well worth a close look.—JBB

Qualitative Engineering

NUCLEAR POWER ENGINEERING. By Henry C. Schwenk and Robert H. Shannon. McGraw-Hill Book Co., New York. 319 pages. $6.50.

"We, the authors, sincerely hope that all the material in this book has given you, the reader, a better understanding of the fundamentals and problems of designing nuclear power plants. We want to caution you strongly that the design we have just been talking about has been greatly simplified to emphasize the main points."

Those two sentences in the conclusions to this book pretty well indicate what it's about. The book is intended to familiarize the layman or the non-nuclear engineer with the elements of nuclear generation. It will satisfy the curiosity of a good many chemical engineers.

Material in this book originally appeared in the McGraw-Hill magazine *Power*, beginning with the July, 1954, issue. The material has been rearranged and

augmented in casting it into book form.

This book covers the field from particle emission to reactor systems and auxiliaries to economics and the various reactor programs. It's well written and clear. There is a very good chapter on reactor loop components.

However, some readers will be disappointed with the lack of quantitative treatment. In this respect, perhaps, the title is a misnomer. Rough calculations like those, for example, in the chapter on designing a nuclear reactor, won't qualify the book, in the eyes of some, for the "engineering" part of the title.

There's a lot of information, but not too much engineering.—JBB

Scale-up Methods

PILOT PLANTS, MODELS AND SCALE-UP METHODS IN CHEMICAL ENGINEERING. By R. E. Johnstone and M. W. Thring. McGraw-Hill Book Co., New York. 307 pages. $9.50

Reviewed by Utah Tsao.

This book should be of interest to chemical engineers concerned with the design of pilot plants and models and the scaling up of experimental results.

The first part of the book presents the principle of similarity, the regime concept, similarity criteria and scale equation quite clearly. More than half of the book is devoted to the application of this principle to the scale-up equations for various chemical engineering equipment including duct and flow passages, filters, heat transfer equipment, packed towers, mixing equipment, chemical reactors, furnaces and kiln, mills, nozzles, atomizers and extruders. The approach is analytical and quantitative and therefore a lot of mathematics is involved. However the results of derivation are presented in simple equations for easy use.

The authors' greatest contribution to the subject is to make engineers realize how complex is the problem of scale-up. In many chemical engineering operations so many factors are interrelated in such a way that

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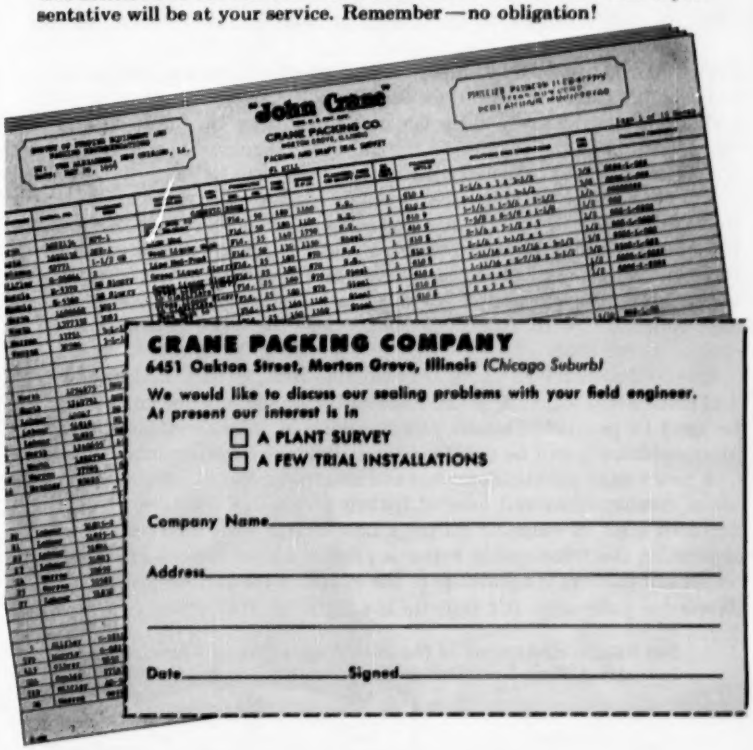

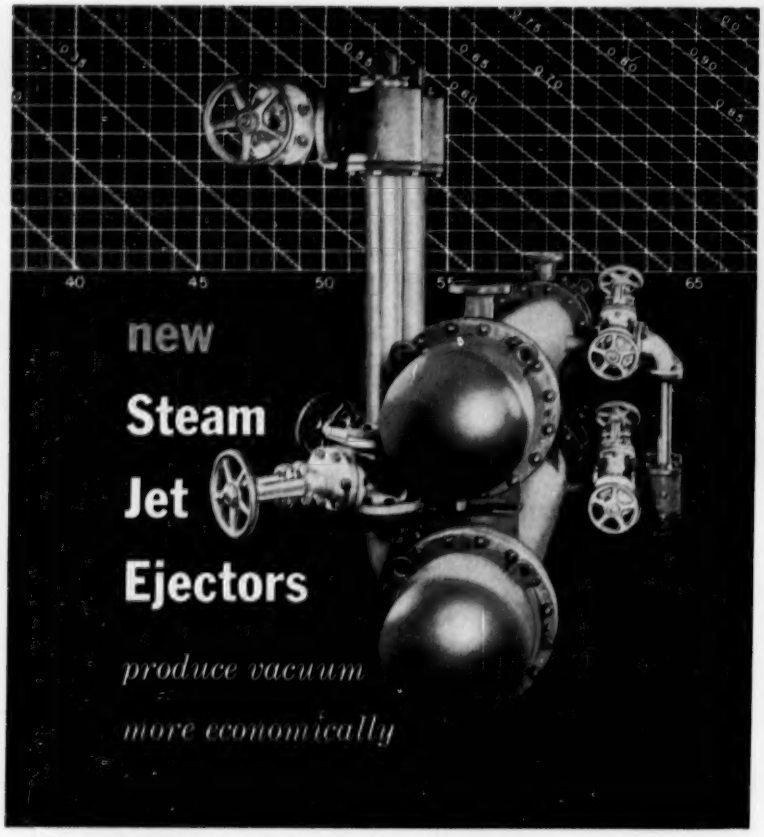

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ENGINEERS AND CONSTRUCTORS...MANUFACTURERS

they have not been isolated at the present time. However, the authors have presented the general theory and application of analog models in the last chapter for operations where all factors are known.

An extensive bibliography classified by subjects at the end of the book is useful.

BRIEFLY NOTED

ASPHALT COMPOSITION AND PROPERTIES. 27 *pp. Florida Engineering and Industrial Experiment Station, College of Engineering, University of Florida, Gainesville, Fla.* Gives composition and colloidal, flow and other properties of asphalts; discusses composition as affected by processing.

DESIGN OF A HEAT PUMP BURIED COIL. *Bulletin No.* 139; *Texas Engineering Experiment Station, College Station, Tex.* $2. Result of about 10 years' research; describes basic equation to determine length and configuration of a heat pump buried installation.

FISCHER-TROPSCH SYNTHESIS MECHANISM STUDIES: ADDITION OF RADIOACTIVE ETHANOL TO THE SYNTHESIS GAS; ADDITION OF RADIOACTIVE METHANOL, CARBON DIOXIDE AND GASEOUS FORMALDEHYDE. *By R. J. Kokes, W. Keith Hall and P. H. Emmett. Mellon Institute,* 4400 *Fifth Avenue, Pittsburgh* 13, *Pa. Free.* Describes studies of Fischer-Tropsch mechanism.

FUNDAMENTALS OF COMBUSTION OF GASEOUS FUELS. 63 *pp. By S. A. Weil, R. T. Ellington, E. F. Searight and S. Hu. Institute of Gas Technology, Technology Center, Chicago* 16, *Ill.* $5. Gives conclusions and references to a critical literature review; 57 pp. of discussion.

INDUSTRIAL WATER AND INDUSTRIAL WASTE WATER. 52 *pp. American Society for Testing Materials,* 1916 *Race St., Phildelphia* 3, *Pa.* $2. Papers from symposium sponsored by ASTM Committee on Industrial Water; papers on waste treatment and sea water purification.

NEUTRON AND GAMMA IRRADIATION FACILITIES. 79 *pp. U.S. Atomic Energy Commission. Superintendent of Documents, U.S. Government Printing Office, Washington* 25, *D. C.* 60¢. Describes the 40 irradiation facilities either

operating or expected to go into operation soon in the U. S. Explains services provided and tells how to obtain them.

PHYSICAL AND THERMODYNAMIC PROPERTIES OF HELIUM. 81 *pp. Wm. R. Whittaker Co., Ltd.*, 915 *North Citrus Ave., Los Angeles, Calif.* $10. Gives properties in the range 14.7 psi. to 6,000 psi. and minus 440 F. to plus 600 F.

PRODUCTIVE USES OF NUCLEAR ENERGY. 61 *pp. National Planning Assn.*, 1606 *New Hampshire Ave., N. W., Washington* 9, *D. C.* $1.50. Result of project of NPA special committee on productive uses of nuclear energy; summary of findings, policy suggestions.

U. S. RESEARCH REACTORS. 73 *pp. Office of Technical Services, U. S. Dept. of Commerce, Washington* 25, *D. C.* $1.50. Describes more than 30 research reactors now operating or under construction.

CATALYTIC DECOMPOSITION OF NITRIC OXIDE. 23 *pp.* $1.50. *By Charles H. Riesz, Fred L. Morritz and Karl D. Franson, Armour Research Foundation of Illinois Institute of Technology. Air Pollution Foundation, 704 S. Spring St., Los Angeles* 14, *Calif.* Presents data on catalytic decomposition studies carried out for Air Pollution Foundation. Describes experimental methods.

CHEMICAL SURFACE TREATMENT OF TITANIUM. 43 *pp.* $1.25. *By H. A. Pray, P. D. Miller and R. A. Jeffreys of Battelle Memorial Institute. U. S. Department of Commerce, Washington* 25, *D. C.* Describes development of chemical baths for surface coating titanium and its alloys.

MORE NEW BOOKS

ELEMENTS OF HEAT TRANSFER. By Max Jakob and George A. Hawkins. McGraw-Hill. $6.75.

FREE RADICALS IN SOLUTION. By Cheves Walling. Wiley. $14.50.

INTRODUCTION TO FLUID MECHANICS AND HEAT TRANSFER. By J. M. Kay. New York: Cambridge University Press. $7.

POLYETHYLENE. Plastics Application Series, Vol. 1. By Theodore O. J. Kresser. Reinhold. $4.95.

QUANTITATIVE INORGANIC ANALYSIS. By G. Charlot and Denise Bezier, translated by R. C. Murray. Wiley. $15.

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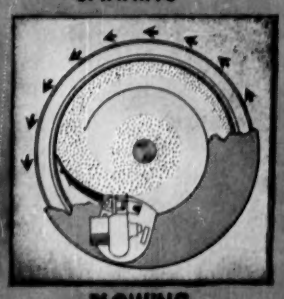

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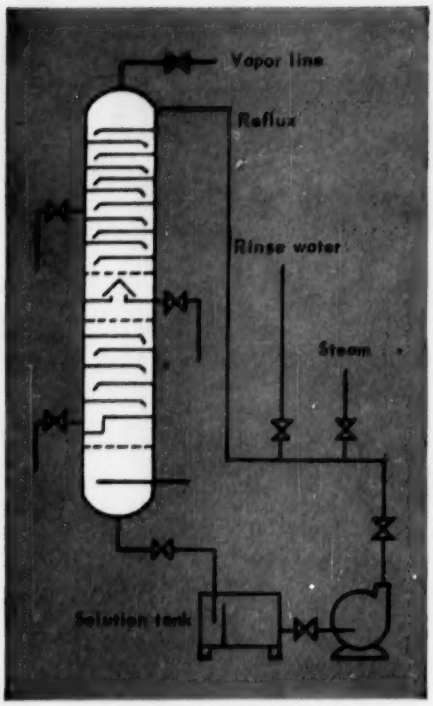

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Morris Sandel, Jr.

RE-EVALUATE YOUR CAPITAL INVESTMENTS. PAGE 231.

Among his duties as assistant to an autonomous division manager of Reynolds Metals Co., Morris Sandel evaluates capital investments and recommends approval or disapproval for expenditure.

In this post and in his previous position as division industrial engineer, he saw the need for a more comprehensive treatment of investment costs. One project, for instance, which would show a good return on the cash required was not charged for all the company facilities which it used. On the other hand, another project showing the same return on cash may use few existing facilities.

In the current article, he proposes a method of including existing facilities in the investment cost in addition to customary cash requirement. The system is especially appropriate for firms that can invest in one of several processes or have a wide field from which to select expansion projects.

Incidentally, the article is an individual contribution; not a company work. The system has not been adopted by Reynolds though company management agrees that it has some very interesting points.

Sandel's varied experience in industry includes work on plastic production, chemical process development, atomic energy administration and engineering

AUTHORS

M. A. GIBBONS

economics for a large alkali company.

Our author is 37 years old and married, with one child. He earned his B. S. in chemical engineering from Rice Institute in 1943. Since that time, he has done additional work in business and in journalism, at Western Reserve University, Cleveland, Ohio.

James P. Kelleher

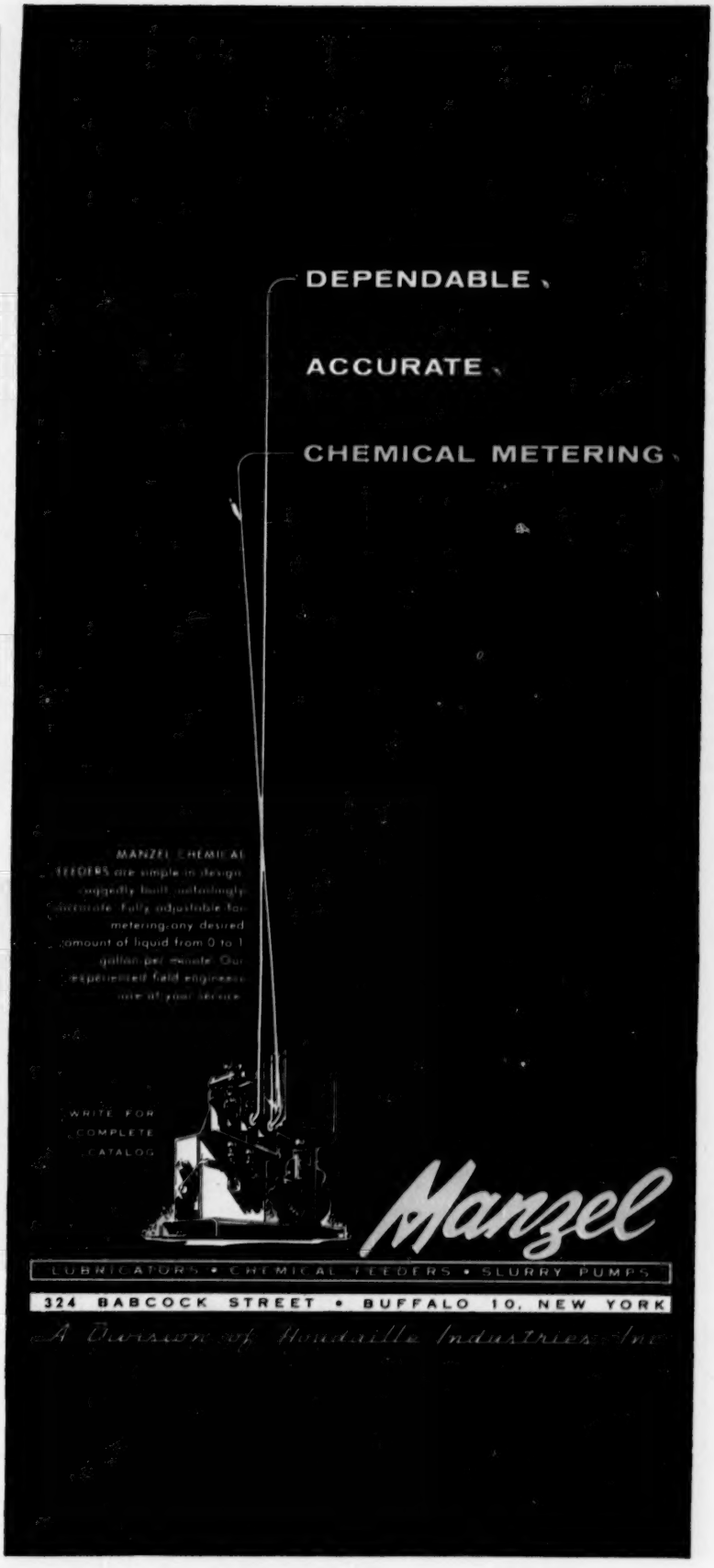
PLASTICS VIE WITH METALS. PAGE 296.

Because of his general interest in materials engineering and his specific interest in corrosion, James Kelleher chose an engineering material study on rigid polyvinyl chloride piping as his topic for a master's thesis. The current article is a part of that thesis which he submitted.

Presently, Kelleher works for the Alloy Tube division, Carpenter Steel Co., as assistant manager of product engineering and development. In this post, he's concerned with engineering materials and their proper selection and application to resist corrosion and perform other specialized services.

Kelleher is a graduate of Newark College of Engineering. He earned both his bachelor's and master's degrees in chemical engineering there as well as membership in Tau Beta Pi.

Before joining Carpenter Steel in 1953, Kelleher worked in process engineering for Esso Standard Oil Co. and did research and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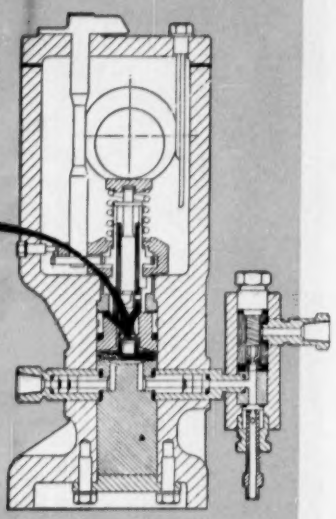

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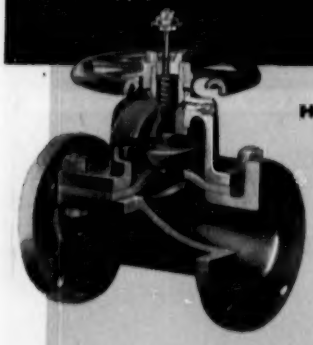

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AUTHORS . . .

development work with the Army Chemical Corps.

Professional activities include membership in the American Institute of Chemical Engineers and the National Association of Corrosion Engineers.

He considers golf his principle non-professional activity.

Edward G. Scheibel

HOW TO DESIGN OPTIMUM EXTRACTION COLUMNS FOR OVER-ALL COST. PAGE 238.

After five years as plant superintendent for the H. C. Bugbird Co., Carlstadt, N. J., Edward Scheibel decided that his interests were more closely allied with design and development than with production supervision.

At this point in his career, he joined M. W. Kellogg and, later, Hydrocarbon Research, Inc., in New York City. Next, he took on a post as research associate at the Polytechnic Institute of Brooklyn. Then, in 1945, he began a ten-year stint as head of chemical engineering design and development work for the Hoffmann LaRoche Co., in Nutley, N. J. Most recently, York Process Equipment Corp. appointed him director of engineering.

In the meantime, though, he also put in ten years (1942-1952) as an adjunct professor at Brooklyn Poly and the past five years in a similar post at Newark College of Engineering.

Scheibel is quite active in professional societies and has also found time for some lecturing before various technical groups. What's more, he has to his credit over forty publications on diffusional operations of ex-

traction, distillation and absorption, physical chemistry and thermodynamics.

Nearly all of the usual hobbies have interested him at one time or another and, like many other engineers, he putters avidly at "do-it-yourself" projects. Between overhauling his old automobiles, and remodeling his house and bungalow, he has become as proficient with a hammer, wrench, pipe-stock, soldering iron and paint brush as he is with a slide rule.

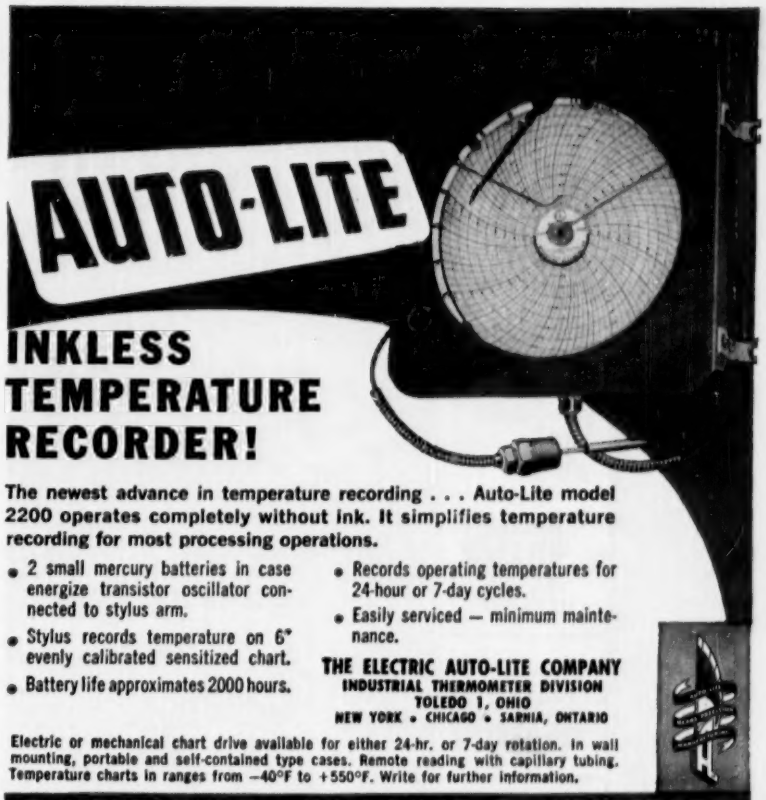
Norbert W. Luft

EQUILIBRIUM CONSTANTS VIA NOMOGRAPH. PAGE 235.

Author Norbert Luft was born at Emmendingen in the Black Forest area of Germany, in 1919. Before the war and at its beginning, he studied at Karlsruhe, Brno and Prague Institutes of Technology. He earned his diploma in chemistry, with a thesis on the structural analysis of proteins, from Prague University in 1941.

After brief employment at Konigsberg University, he became a staff member of the rocket research station at Peenemunde, on the Baltic Sea. There, he carried out work on catalysts, special fuels properties and performances, ignition and combustion. His studies on catalysts for hydrogen peroxide decomposition, which date from this period, are still of some relevance for present day developments in the field, and for a general understanding of high-rate heterogeneous catalysis as well.

At the end of the war, Luft worked in research and thermodynamic and kinetic problems



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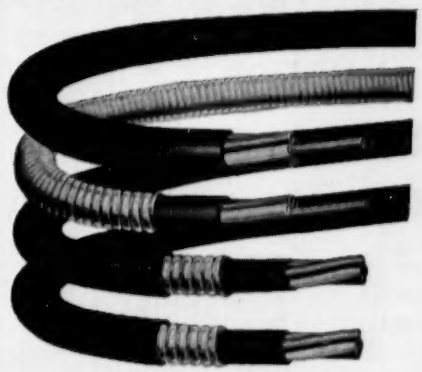

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DENVER (patented) **SUPER AGITATORS and MIXERS**		3'x 3' to 20'x 20'	Patented standpipe around propeller shaft assures positive agitation and circulation. Patented wearing plate prevents sand-up on shut-down. Heavy duty as well as acid-proof construction is available in both open type, air lift and Super Agitator models. Please write for Bulletin No. A2-B4.
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AUTHORS . . .

at the British Ministry of Supply. Then, from 1952 until 1955, he was in charge of the chemistry research section of Simon-Carves Ltd.—a Stockport, England, engineering firm.

Next, he joined Petrochemicals Ltd., Manchester, England, subsidiary of Shell Petroleum Co. Ltd. There, he directed fundamental work, on the kinetic and chemical-engineering basis of heterogeneous polymerization of olefines and then acted as an adviser on petrochemical problems.

While still a resident in England, he also took charge of the development of an organic chemicals plant for a rapidly expanding engineering firm in Frankfurt, Germany.

Luft holds some forty patents and applications on fuels, catalysts and various chemical processes. He has published extensively in American, Austrian, English and German technical journals. And, in 1955, he lectured at the Royal Technical College of Salford, England, in a course on reactor design.

James H. Weber

PURE SUBSTANCE ENTHALPY AND ENTROPY. PAGE 245.

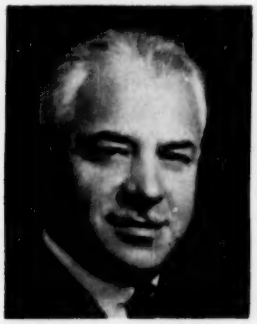
Author James H. Weber, like Co-author Hobson chose his career in chemical engineering education. Currently, he is associate professor of chemical engineering at the University of Nebraska.

Weber earned his own degrees in chemical engineering at the University of Pittsburgh: a bachelor's in 1941, a master's in 1947 and his doctorate in 1948.

Professional associations in-

clude the American Chemical Society, the American Institute of Chemical Engineers, the American Society for Engineering Education and Sigma Xi.

In the past, Weber was a frequent contributor to Petroleum Processing magazine.



Charles L. Mantell

PLASTICS VIE WITH METALS. PAGE 296.

Consulting Chemical Engineer Charles L. Mantell is also a professor of chemical engineering at Newark College of Engineering and chairman of the school's department of chemical engineering as well.

As an author, he has chalked up quite an admirable record. for one thing, he is editor-in-chief of the "Engineering Materials Handbook" (McGraw-Hill Book Co.); author of "Industrial Electrochemistry," (third edition with a fourth on the way) and of "Adsorption," (both part of the McGraw-Hill Series in Chemical Engineering); contributor to Perry's "Chemical Engineer's Handbook" and numerous encyclopedias.

As a New York consultant, Mantell has been responsible for the design and construction of numerous plants in the United States, Canada and, for that matter, throughout the world. Work was done for private companies as well as various governmental agencies here and abroad.

Mantell has earned mention in Who's Who in America since 1938. Professional memberships include: the American Institute of Chemical Engineers; the American Institute of Mining, Metallurgical, and Petroleum Engineers; the American Chem-

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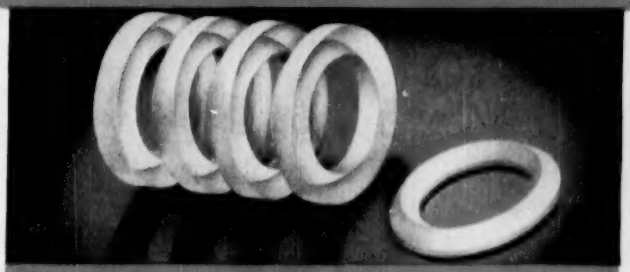

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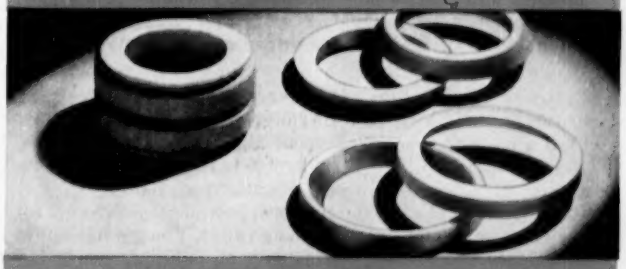

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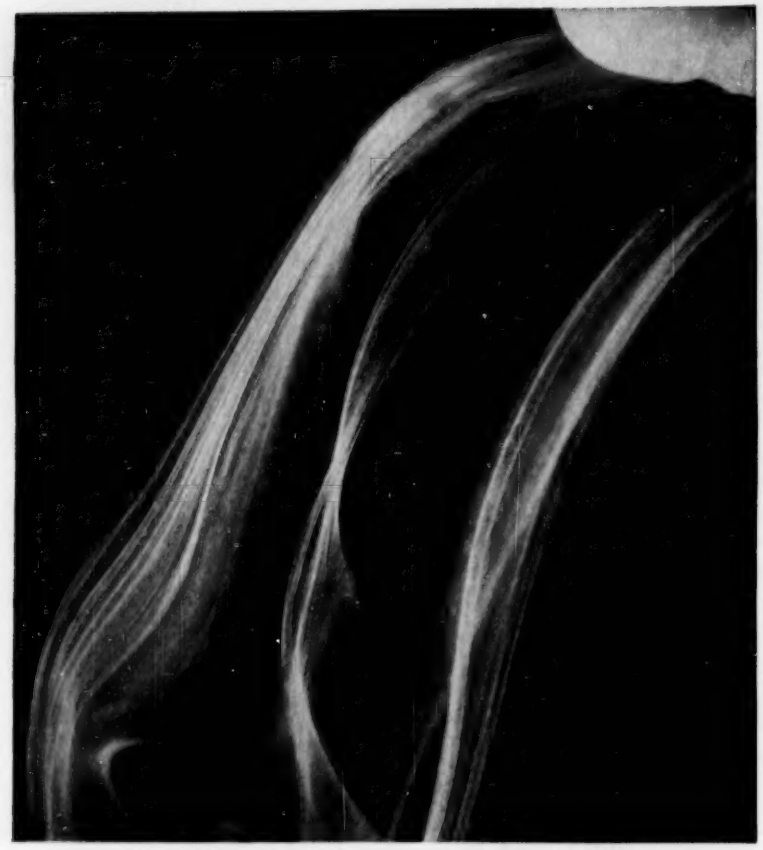

Photographer Bernard Hoffman found even the free flow of CO_2 from a cake of dry ice is difficult to control.

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AUTHORS . . .

ical Society, the American Society for Metals and The Electrochemical Society. He is a registered professional engineer in New York and in a number of other states.

John R. Donovan

DON'T WRITE OFF THE BATCH PROCESS. PAGE 241.

Since 1954, John Richard Donovan has worked as group leader in Monsanto Chemical's inorganic division research department. Before that time, he was located at the firm's plant in Monsanto, Ill.—for a while, as chemical engineer and later as group leader. Actual work, involving plant trouble-shooting and improvement, gave him a good perspective of the batch-vs.-continuous-process problem since the plant produces over 100 different chemicals in a variety of operations ranging from large scale continuous to small batch units.

Donovan's history with Monsanto dates almost back to graduation from college. After he earned his first degree in chemical engineering from Washington University, in 1939, he joined Burkart Mfg. Co. As a junior engineer, he did development work on applications of the firm's fibers in plastics products. Six months later, he joined Monsanto; early in his career there he served as technical assistant to a chlorine plant supervisor, plant chemist on a Chemical Warfare Service unit, and chemical engineer in reactor development at the Monsanto-operated Clinton National Laboratories.

Donovan delivered a series of lectures to the senior chemical

engineering classes of Washington University, St. Louis, Mo., (April 1954, February 1955) and to similar classes at Missouri University, Columbia, Mo., (November 1954). The lectures were arranged by the St. Louis section of the AIChE as part of the courses on chemical engineering design, with industry lecturers.

The article which appears in this issue was based on these talks.

Donovan is married to the former Mildred Thorwegen. Their three children: Mike, Steve and Susan are aged 15, 13 and 10, respectively. As a parent, Donovan reports that he has done the usual tours of duty in the St. Louis, Mo., PTA and Cub Scouts. Vacations are usually spent on one of the 30,000 islands of Georgian Bay (Ont., Canada) getting in some good swimming, fishing and sailing. But, during the rest of the year, spare time is pretty well limited to home and yard maintenance. Says our disgruntled author, "Though my house adjoins Crystal Lake Golf Course, I'm usually too busy to play—doggonit!"

Ray S. Long

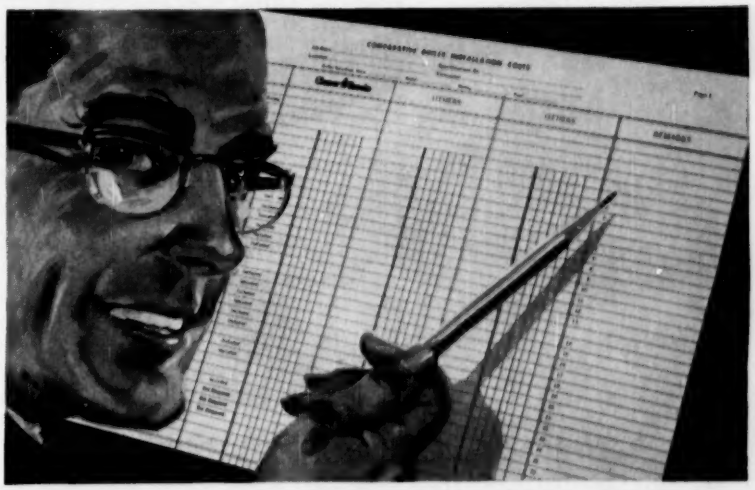
SOLVENT EXTRACTION OF URANIUM. PAGE 251.

This article is the outgrowth of a cooperative project between Dow Chemical Co. and the U. S. Bureau of Mines.

Ray Long and Co-author Glenn Shaw did a portion of the preparation of the article while actually in temporary residence at the Bureau of Mines in Salt Lake City. This was during an eighteen-month period in 1955

Before you buy any boiler

compare quoted prices with REAL COSTS.



New Cleaver-Brooks cost analyzer clears "quotation" confusion — reveals ALL costs

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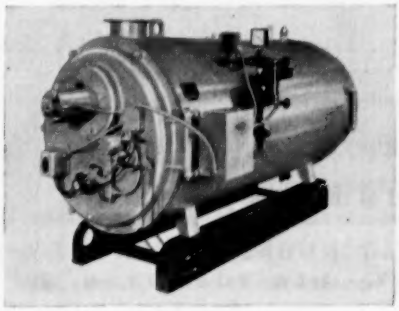

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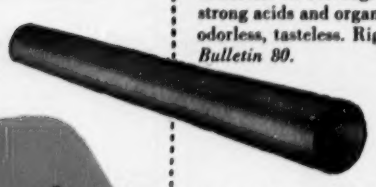

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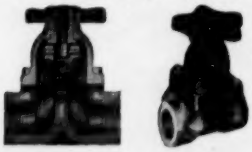

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AUTHORS . . .

and 1956. And, it was at this time, too, that the idea for writing it was actually conceived.

Ray started out with Dow in the research department of the firm's western division in 1948 as a research and project development engineer. Major work all along has been in the uranium field and has involved laboratory and pilot plant work on ion exchange and solvent extraction processes for recovery of uranium and other metals.

Present post at Dow is research project leader of the western division's AEC group.

He attended the University of California at Berkeley from 1942 to 1948, with the exception of two years in the Navy which were well spent as an instructor in a naval electronics school. He took his first degree in physical chemistry and later earned his master's in chemical engineering.

Hobbies include folk dancing and ice skating. Professional activities are tied up with the American Chemical Society, the American Institute of Chemical Engineers and Sigma Xi.

Merk Hobson

PURE SUBSTANCE ENTHALPY AND ENTROPY. PAGE 245.

Author Merk Hobson is now assistant dean at the University of Nebraska's College of Engineering & Architecture.

Before he settled on the engineering campus, he spent some time working with Esso Standard Oil Co. (Louisiana) and with the Pure Oil Co.

He received his B.S. degree in chemical engineering in 1943 from the University of Wiscon-

sin and a Ph. D. in 1951 from Northwestern University, Evanston, Ill.

Professional memberships include the American Chemical Society, the American Institute of Chemical Engineers and the American Society for Engineering Education.

K. Glenn Shaw

SOLVENT EXTRACTION OF URANIUM. PAGE 251.

Research and development engineer K. Glenn Shaw is now working for Dow Chemical's western division in Pittsburg, California.

Like Co-author Long, Shaw has had extensive experience in the field of extraction metallurgy and solvent extraction. In fact, Shaw has spent the last six years working exclusively on development problems in this field.

Three years of this time were devoted to thorium and rare earths at Ames Laboratory of Iowa State College located in Ames, Iowa. The other three years were devoted to the uranium recovery and slurry solvent extraction work leading up to this article.

Educational background includes two years in the Navy's V-12 program during the war, a bachelor's in chemical engineering from Penn State in 1948 and a doctorate from Iowa State in 1953.

All of Shaw's industrial experience has been with Dow except for one year when he worked for Monsanto.

Glenn is married and has three daughters. Interests, outside of his family and his work, include an amateur radio and a rather fine garden.

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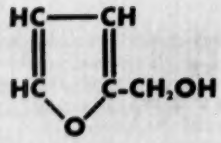

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PEOPLE . . .

LETTERS:

Cost Estimation Data

Sir:

I believe that your magazine has published many articles on how to estimate chemical equipment costs. I would appreciate it if you would send me a list of the most informative reprints which would cover this rather vast subject.

The articles I have in mind would consider such factors as materials of construction, design sizes and complexity as they affect costs for different types of chemical equipment, such as pumps, heat exchangers, reactors, vessels, tanks and columns.

J. C. MacKellar
Professional Engineer
Chateauguay Co., Que.

▶ *Most of our cost estimation articles of the past ten years have been available in reprint form as Parts 1, 2 and 3 of "Data and Methods for Cost Estimation."*

Parts 1 and 2 have been exhausted and will not be reprinted. However, a new, comprehensive reprint of some 500 pages, covering all worthwhile material we have published in this field through 1957, will be available early next year. Watch for announcement in our pages.—Ed.

Pro: Strong-Man Stunt

Sir:

Frank Anderson's plea for an unstapled *Chemical Engineering* (Sept. 1957, p. 348) that can be dismembered for filing without using a screwdriver and pair of pliers prompts me to offer my solution to this problem.

All I do is lay the magazine on my lap and open it just back of Corrosion Forum (p. 318 in the September issue). Grasping the two halves of the magazine firmly along the outer edges of the pages, I raise it level with the top of my head and bring it down sharply on my knee. With a little practice you'll find that one blow straightens out the staples so that the pages peel off easily.

Just one word of caution.

PRO & CON

C. H. CHILTON

Take care to protect your knee with a folded newspaper. Otherwise, those 500-page issues of *CE* will feel like a wooden plank descending on your knee.

ROBERT ACKERMAN
Eastman Kodak Co.
Rochester, N. Y.

Pro: Solving the Shortage

Sir:

In an effort to help maintain and strengthen our great American heritage of scientific and engineering leadership, Victor Chemical Works sponsored a "talent scout" contest in which men and women in industry were invited to submit their ideas which might stimulate the interest of young people in seeking careers in science and engineering. As a result, the judges received many ideas presented in these suggested programs which they considered worthwhile. Winners received the opportunity to choose a high school graduate for a scholarship.

Victor management decided to transmit these ideas to outstanding educators, editors and industrial leaders who might be in a position to use them effectively. To accomplish this objective, we have prepared a digest-type booklet, "Shortage of Scientists." Victor has prepared a reasonable quantity of the booklets, and additional copies are available.

E. M. MYERS
Victor Chemical Works
Chicago, Ill.

Con: Hard-Luck Stories

Sir:

In the article, "What It Costs to Change Your Job" (Aug. 1957, pp. 313-316), I believe a serious problem facing many engineers was discussed in a frivolous manner.

Just as any engineer knows that one point does not make a graph, one hard-luck story does not present a complete picture. The article was so laden with pointed remarks that one begins to wonder whether your

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J. V. Calhoun Co.
349 Montgomery Ave.
MOhawk 4-6113

BALTIMORE 18, MD.
Paul V. Renoff Co.
333 E. 25th St.
HOpkins 7-3280

BLOOMFIELD, N. J.
R. L Faber & Associates, Inc.
1246 Broad Street
EDison 8-6900

BOSTON 11, MASS.
Leo C. Pelkus and Co., Inc.
683 Atlantic Ave.
Liberty 2-1941

BUFFALO 2, N. Y.
Niagara Electric Sales Co.
505 Delaware Avenue
SUmmer 4000

CHARLOTTE 2, N. C.
Ranson, Wallace & Co.
116½ East Fourth St.
EDison 4-4244
FRanklin 5-1044

CHATTANOOGA 1, TENN
H R. Miles and Associates
P. O. Box 172
Phone 5-3862

CHICAGO 6, ILL.
Fred I. Tourtelot Co.
407 S. Dearborn Street
HArrison 7-5507

CINCINNATI 8, OHIO
The Smysor Company
1046 Delta Avenue
TRinity 1-0605

CLEARWATER, FLA.
J. J. Galleher
617 Cleveland Street
P. O. Box 1376
Phone 3-7706

CLEVELAND 13, OHIO
Anderson-Bolds, Inc.
2012 W. 25th Street
PRospect 1-7112

DALLAS 28, TEXAS
L. R. Ward Company
3009-11 Canton Street
RIverside 1-6279

DAVENPORT, IOWA
Volco Company
215 Kahl Bldg.
Phone: 3-2144

DENVER 2, COLO.
E. & M. Equipment Co.
2415 15th Street
GLendale 5-3651
GEnesee 3-0821

DES MOINES 14, IOWA
Midwest Equip. Co. of Iowa
842 Fifth Avenue
CHerry 3-1203

DETROIT 38, MICH.
Carman Adams, Inc.
15760 James Couzens Hwy.
UNiversity 3-9100

HOUSTON 3, TEXAS
L. R. Ward Company
3605 Polk Avenue
CApitol 5-0356

INDIANAPOLIS 4, IND.
Couchman-Conant, Inc.
627-631 Architects & Builders Bldg.
MElrose 5-5313

KANSAS CITY 8, MO.
Fraser D. Moore Co.
106 E. 14th Street
Victor 2-3306

LOS ANGELES 15, CALIF.
Montgomery Brothers
1053 South Olive Street
RIchmond 7-9401

MIDDLETOWN, CONN.
Dittman and Greer, Inc.
33 Pleasant Street
DIamond 6-9606

MILWAUKEE 3, WIS.
Gordon Hatch Co., Inc.
531 W. Wisconsin Avenue
BRoadway 1-3021

MINNEAPOLIS 4, MINN.
Volco Company
831 South Sixth Street
FEderal 6-3373

NASHVILLE 4, TENN.
H. R. Miles and Associates
2500-B Franklin Road
CYpress 2-7016

NEW YORK CITY, N. Y.
See "Bloomfield, N. J."
WOrth 4-2990

OMAHA 2, NEB.
Midwest Equipment Co. of Omaha
1614 Izard Street
ATlantic 7600

PHILADELPHIA, PA.
See "Bala-Cynwyd, Pa."
GReenwood 3-4477

PITTSBURGH 6, PA.
Woessner-McKnight Co.
1310 Highland Bldg.
115 S. Highland Avenue
EMerson 1-2900

PORTLAND 9, ORE.
Montgomery Brothers
1632 N.W. Johnson Street
CApitol 3-4197

RICHMOND 26, VA.
(Branch, Charlotte)
Phone 88-8758

ROCHESTER 4, N. Y.
Niagara Electric Sales Co.
133 Clinton Avenue, South
HAmilton 6-2070

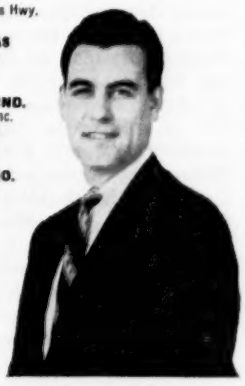
ST. LOUIS 1, MO.
C. B. Fall Company
317 North 11th Street
CHestnut 1-2433

SAN FRANCISCO 3, CALIF.
Montgomery Brothers
1122 Howard Street
UNderhill 1-3527

SEATTLE 4, WASH.
Montgomery Brothers
911 Western Avenue
SEneca 3270

SYRACUSE 6, N. Y.
R. P Smith Co., Inc.
2507 James Street
HOward 3-2748

WICHITA 2, KANS.
Fraser D. Moore Co.
Room 211 Derby Building
352 N. Broadway
AMherst 2-5647



PRO & CON . . .

motive in publishing the article was to discourage engineers from moving from their present jobs rather than to present factual information.

It is wise for an engineer to be aware of the expense of changing jobs, but often there are personal motives involved which cannot be measured in dollars and cents.

G. JERRY DAVIS
National Carbon Co.
Niagara Falls, N. Y.

▶ *Whether its from a chemical engineer or a Times Square panhandler, we've learned always to take hard-luck stories with a grain of salt.*—ED.

Pro: Teaching Aids

Sir:

I have read with much interest your article, "Guide to Process Instrument Elements," which appeared in your June issue (pp. 287-320). This is the sort of information that I would like to include in my laboratory course in physical chemistry for chemical engineers. I would like to obtain six reprints of this article for myself and my graduate students.

GILBERT J. MAINS
Carnegie Institute of Technology
Pittsburgh, Pa.

Sir:

We would like to obtain 40 copies of "Handling Compressible Fluids," which you published in June 1956 (pp. 175-238). We are using this material in a course being taught at our company and would appreciate receiving it as soon as possible.

PAT RANDALL
Clark Bros. Co.
Olean, N. Y.

Our Joint Is Jumping

INTER-OFFICE MEMORANDUM
To: Elton Tuohig, NY
From: Pete Carberry, LA

There is a honey of a typo on page 200 of the August issue of *Chemical-Enpineering.* There is something absolutely macabre, I'm sure, about the soul of a typesetter who writes it "Bryon Jackson Jumps" instead of Bryon Jackson Pumps.

Maybe you can get John Callafam to run an apology in his pro # Cin department.

How small is . . . .

one ppm?

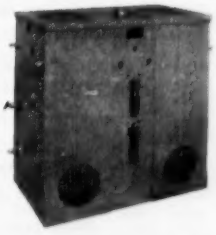
Can you visualize only three people in the city of Los Angeles? A city with a normal population of approximately 3,000,000 people?

It is 3048 miles from Washington, D.C. to San Francisco. One ppm of this distance is only .003 of a mile — not .3 of a mile (the smallest division on your automobile speedometer) but .003 of a mile!

It is approximately 25,000 miles around the earth at the Equator. One ppm of this distance is only .025 of a mile — not very far!

These examples are representative of the term "1 ppm", and, more important, are representative of the degree of purity obtained in your industrial gas purification problems when you use equipment designed and manufactured by Air-Dry Corporation of America.

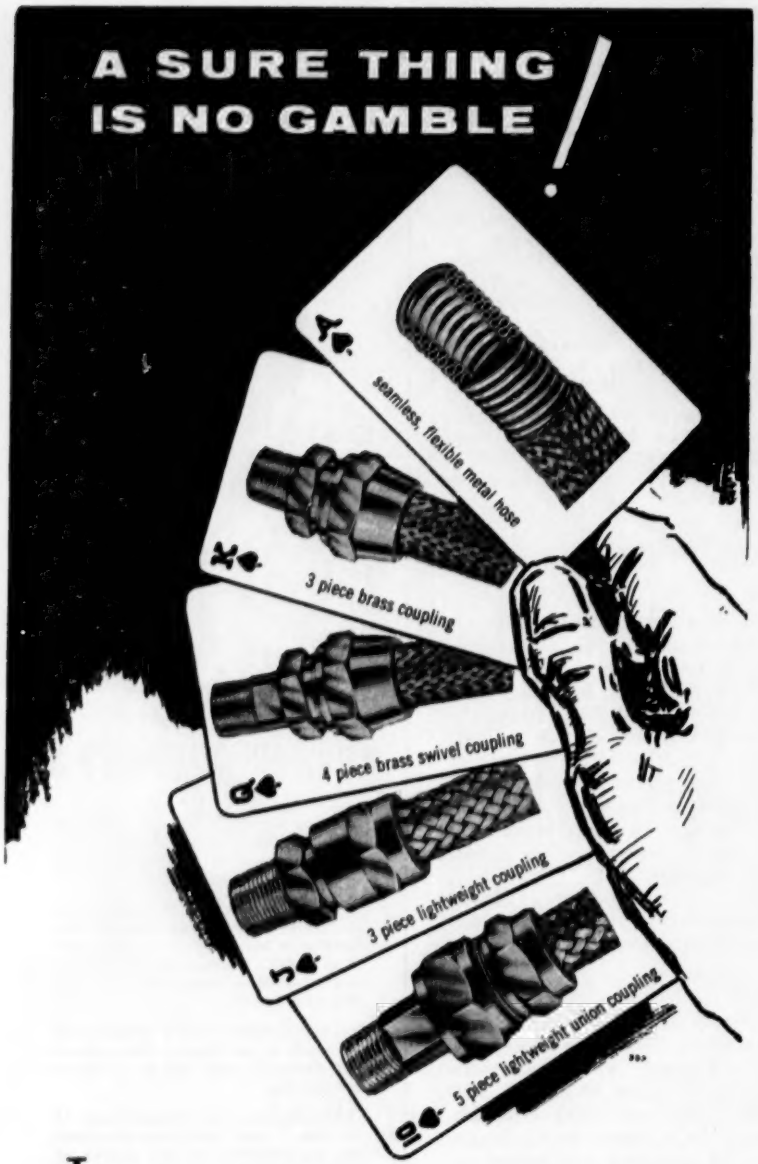
A TYPICAL AIR-DRY UNIT



Complete information about AIR-DRY CORPORATION its products and their uses may be obtained by writing
Dept. C E

AIR-DRY CORPORATION OF AMERICA

14756 KESWICK STREET, VAN NUYS, CALIFORNIA


A SURE THING
IS NO GAMBLE!
seamless, flexible metal hose
3 piece brass coupling
4 piece brass swivel coupling
3 piece lightweight coupling
5 piece lightweight union coupling

In a poker game or in flexible metal hose connectors *this* hand *on* hand, means money in your pocket.

The Packless® PATENTED RE-USABLE COUPLINGS are fitted without heat by a simple, clean mechanical process. accomplished in minutes at *your* plant.

Hand machined of top quality brass, applied and reapplied with ease, Packless® couplings are ideal in excessive movement where heat weakened soldered or brazed joints won't stand up.

For longest connector life, stock Packless® seamless drawn helical metal hose in random lengths for use as required with Packless® re-usable couplings. Sizes from ¼" to 1½" I.D.

Send now for your copies of Bulletins DC and IND-4 for complete detailed information

PACKLESS METAL HOSE INC.

730-51 S. Columbus Ave., Mt. Vernon, N. Y.

PEOPLE . . .

NAMES IN

J. Elton Tuohig

Former district manager of advertising sales for *Chemical Engineering* in New York—J. Elton Tuohig—has been appointed the magazine's advertising sales manager.

After graduating from Newark College of Engineering with a bachelor's degree in chemical engineering, Tuohig held a variety of engineering posts with Davis Engineering Corp. and Reichhold Chemicals. Ordered to active duty with the Navy in 1941, he spent some four and a half years working on specialized aeronautical engineering projects. When he was discharged—with the rank of lieutenant commander—he rejoined Reichhold Chemicals as process engineer in charge of post-war expansion at the firm's Elizabeth, N. J., plant.

In 1950, Elton joined McGraw-Hill as advertising representative for *Chemical Engineering*.

Last year, Elton was a director of the Industrial Advertising Association of New York, which voted him the outstanding "Space Salesman of 1956." During the past year, he served as a lecturer at the Sales Engineering Conferences offered by Newark College of Engineering. Other professional activities are tied up with the AIChE and the Salesman's Association of the ACS.

In his new post with *Chemical Engineering*, Tuohig will direct and coordinate national advertising sales. Headquarters will be in New York City.

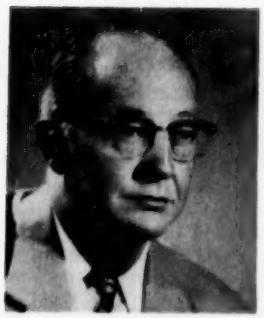
THE NEWS

J. B. BACON

Eldon A. Siegman, has been promoted to senior chemical engineer in the research and development department of American Oil Co. at Texas City, Tex. He'll also continue to serve as group leader in the department's economic section.

Charles J. Benjamin, Jr., has been named assistant to the president of Bard Pharmaceuticals, Inc., Yonkers. Formerly, he had been associated with Nepera Chemical Co.

Arthur Cherkin, vice president and director of research at Don Baxter, Inc., has been chosen to head the firm's newly created international division.



Clinton C. Steward

Holmes & Narver, Inc., engineers and constructors, has named Clinton C. Steward as assistant manager in charge of engineering and process for its petro-chemical division.

Before joining the Los Angeles firm, Steward served for nine years as chief engineer of the Ralph M. Parsons Co. Earlier he held a similar position for the Bechtel Corp. Other experience includes five years as refinery engineer with International Petroleum Corp. in Peru and several years with Foster Wheeler Corp. in New York.

Steward earned his degree in chemical engineering at Val-

Did you ever SEE a Micron?

Well here are 10 of them . . but that ain't all

PRESTO!—another set of nozzles—perhaps a couple of different diffusers with other gizmos, etc., and some of these evil-looking fellows have disappeared. Perhaps 3, 6, or more depending upon what your job needs. Our Engineering Division is just itching to tackle your problem.

Graham

Through constant and intelligent research, Graham has refined the steam and gas propelled ejector until some would say that we had reached the ultimate—from our viewpoint, not so—we intend to go further. Our progress cannot halt—and to any industry that has a need for this exclusive equipment, we are prepared to demonstrate our guarantees.

We invite you to submit your problem to our Engineering Department without obligation and learn the economies and many advantages of the Graham Ejector for absolute pressures that are practically nil.

GRAHAM MANUFACTURING CO., INC.

415 LEXINGTON AVENUE, NEW YORK 17, N. Y.

Offices in principal cities and Canada

A FUMING SCIENTIST DOING IT THE OLD WAY

NOW STEELAB'S NEW WAY SAFE 'n EASY REMOTE CONTROL*

gives you complete AIR FLOW CONTROL inside the fume hood by remote control!

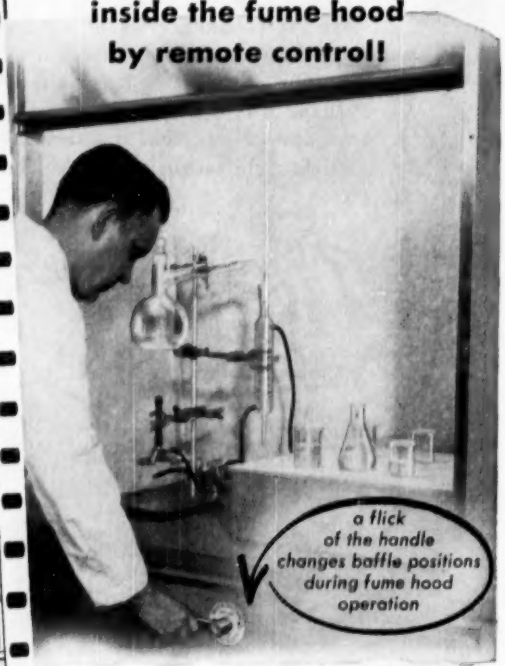
Clears the deck

Crawls into hood

Kneels to adjust baffle

Puts everything back

CONSUMES NEARLY 1 HOUR!


a flick of the handle changes baffle positions during fume hood operation

*Patent No. 2779265 January 29, 1957

Famous for many firsts in the industry, Laboratory Furniture's newest improvement for fume hoods, the SAFE 'n EASY way, provides the perfect answer to an old problem. Now, with one simple motion, you can move the baffle by remote control and change the Air Flow inside the operating fume hood . . . without removing the apparatus, and with the sash open or closed. An exclusive STEELAB and WOODLAB feature!

"STEELAB," Revised Edition. Hundreds of ideas for laboratory furniture layouts.

"FUME HOODS" No. 56H. Most complete fume control prospectus in the industry.

WRITE OR CALL TODAY FOR THESE VALUABLE PLANNING AIDS They're FREE!

LABORATORY FURNITURE COMPANY INC.

Over 35 Years of Specialized Service to Laboratories

MINEOLA, LONG ISLAND, NEW YORK • PHONE: PIONEER 2-3600

paraiso University and did graduate work in distillation at MIT. He is a registered chemical engineer in the state of California.

Roland Labine

Chemical Engineering has added an editorial assistant to its staff. He is Roland (Clem) A. Labine, Jr., who joins CE's developments group under the direction of Senior Associate Editor Cecil Chilton.

Formerly, Clem had been associated briefly with Monsanto Chemical in Springfield, Mass., and with Atlantic Refining's research and development department, in Philadelphia, as a process engineer.

Clem received his bachelor's degree in chemical engineering from Yale last June. While at school, he made the dean's list each year and still had time for such intramural sports as football, basketball and swimming. Student elections did well by him too: He was president of the AIChE student chapter and vice president of Alpha Chi Sigma.

Walter H. Dumke, associate professor of chemistry at the Colorado School of Mines, will head up a committee which will replace the usual department head system supervising activities in the chemistry department.

George M. Tokos and **Hans L. Stene** are both new associate chemists in Crown Zellerbach's Western Waxide Specialty Packaging division, San Leandro, Calif.

Julius E. Spector

Sun Chemical Corp., Long Island City, N. Y., has elected J. E. Spector as a vice president.

Spector was also appointed general manager of the paints and finishes group, a corporate designation for the A. C. Horn companies, subsidiaries and divisions of Sun Chemical.

The new vice president had been associated with the eastern division of National Chemical & Mfg. Co., Inc., Newark, for the past eleven years. There, he held the positions of technical director and plant manager.

William W. Palmquist has been named chemical products marketing manager by National Carbon Co., division of Union Carbide Corp.

Paul D. Bybee, Jr., a chemical engineering graduate of Rice Institute, has been promoted to general superintendent of Freeport Sulphur Co.'s Grande Ecaille sulfur mine.

William E. Thompson has assumed duties as associate chairman of the department of chemistry and chemical engineering at Southwest Research Institute.

R. Rea Jackson, general manager of Socony Mobil Oil Co., Inc., has been appointed chairman of the firm's coordination committee, in New York.

Shell Development Co.'s development division has been reorganized with **Edward Gelus** heading up oil reaction processes; **George E. Liedholm,**

TEFLON*—slipperiest, static-free, solid material known—keeps difficult powders and other dry materials flowing freely through hoppers, chutes, feeders, mixers, packaging machines, etc.—eliminates the need for vibrators and manual attention. And this unique lining material is also corrosion and contamination proof because it is chemically inert.

Cementable TEFLON, Garlock No. 8536, with one side treated and ready for application to any metal, wood, glass, concrete, plastics or other surface, with standard commercial adhesives, is now available in economical thin-section (.005" to .060") continuous tapes up to 12" wide, and in 1/16" and thicker sheets up to 48" x 48" in size.

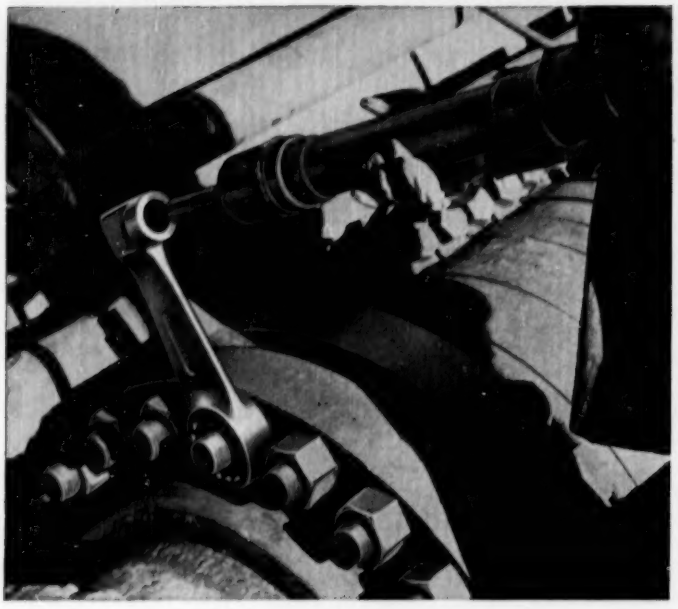
For further information, write for Bulletin AD-158.

*du Pont Trademark

United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

tool idea by Standard



new timesaving wrench by Snap-on*

Standard Oil Company of California needed a wrench to tighten bolts to high tensions . . . eliminate safety hazard of striking wrench with a sledge hammer . . . save time . . . overcome close-quarter limitations.

One of Standard's maintenance foremen conceived the idea of using an air-powered wrench. He outlined his thoughts to *Snap-on* sales engineer, W. F. Egbert. From their combined ideas, Standard built working models using regular *Snap-on* sledge wrenches.

Using these models, *Snap-on* made detailed drawings, then furnished the industry's first cupped-slugging wrenches. The striking surface is cupped so that a bull-nosed driver, inserted in an air-powered rivet buster, can impact the wrench from various angles to tighten the nuts. This tool answered all requirements outlined above.

Whatever your tool problems, *Snap-on* can render a specialized service. Branch offices and warehouses are located in key cities throughout the U.S. and Canada.

SNAP-ON TOOLS
CORPORATION
8106-G 28th Avenue • Kenosha, Wisconsin

NAMES . . .

oil process engineering; **Gino Pierotti**, chemical separation activities. All men are located at the division's Emeryville, Calif., research center.

Frederick A. Tilston has been elected president of Sterling Drug Mfg. Ltd., Windsor, Ont. He succeeds the late **Ralph W. Henderson,** who died last June.

George L. Clarke has been named vice president of mill operations at Southland Paper Mills, Inc., Lufkin, Tex. During the past year, he had charge of starting up the newsprint machine at International Paper Co.'s mill in Mobile, Ala.

Kenneth W. McCrum, director of the research and development laboratories of Space Corp., Dallas, has been named vice president.

Joseph M. Smith

Dean of the college of technology at the University of New Hampshire—Joseph M. Smith—has been appointed professor and chairman of the department of chemical engineering at the Northwestern University Technological Institute.

After completing his formal education at California Institute of Technology and at MIT, Smith was employed as a design engineer by the Texas Co. Later on, he joined Standard Oil Co. of Calif. as a research engineer. He spent a year on the MIT faculty before accepting a post as project engineer with the Publicker Com'l Alcohol Co. in 1943. Then, in 1945, he joined the faculty at Purdue Univer-

sity, where he served until he became dean at New Hampshire earlier this year.

Smith's books, "Chemical Engineering Kinetics," and "Introduction to Chemical Engineering Thermodynamics," are published in the McGraw-Hill chemical engineering series. He has also turned out some 42 research papers.

Jack Tielrooy

Jack Tielrooy has set up a consulting chemical engineering practice in Fullerton, Calif.

Specialties will center in the chemical process industries and will include evaluation of potential projects from technical, market, and economic viewpoints. Services will also include technical consultation on the design of new plants.

Tielrooy had been a vice president of Brea Chemicals, Inc., in charge of engineering and development. Before the formation of the firm, in 1952, Tielrooy was associated with Brea's parent company Union Oil Co. of Calif. and with Shell Chemical Corp. in San Francisco.

Lyman D. Holder has become a member of the production department of Monsanto Chemical's plastics division in Springfield, Mass.

Billy F. Landrum has been appointed group supervisor of the fluoro-chemical section, central research department, Minnesota Mining & Mfg. Co.

Leo DiRicco, Willard Ent and **Albert Momenthy** have joined Air Products Inc., in Allen-

DAY Hy-R-Speed Mills

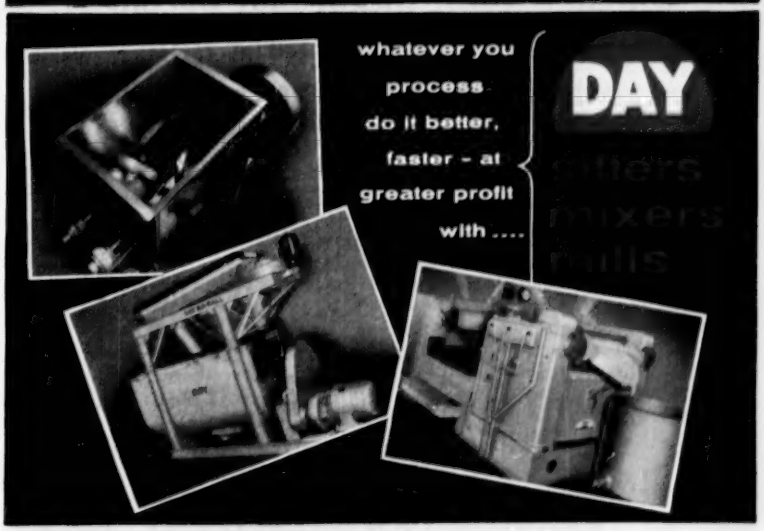
cut your costs 3 ways

DAY Hy-R-Speed Mills insure economical, fast, quality production, and you save 3 ways:

1. **YOU SAVE ON CAPITAL INVESTMENT.** Its attractive price is a result of simplicity of design, a minimum of moving parts. It's built for years of dependable service.
2. **YOU SAVE ON OPERATION COST.** No skilled operator required. Complete clean-up requires less than 5 minutes. Precise particle size controlled by simple adjustment of stationary stone. Gives 4 times the production of ordinary mills.
3. **YOU SAVE ON MAINTENANCE.** Contact parts are rust proof. Stator and rotor stones are interchangeable, reducing inventory needs. Has record for dependable operation.

If you disperse paints, chemicals, inks, plastics or food products, it will pay you to use a Day Hy-R-Speed Mill. Make Day your one source for process equipment.

Write for new bulletin



The J. H. DAY Co. *Division of The Cleveland Automatic Machine Co.,*
4926 BEECH STREET, CINCINNATI 12, OHIO

New QUAKER hose for hot air ducting cuts heat loss up to 57%

OUTSIDE JACKET SURFACE TEMPERATURE (DOUBLE JACKET) 170°F.
OUTSIDE JACKET SURFACE TEMPERATURE (SINGLE JACKET) 235°F.
INSIDE AIR TEMPERATURE 450°F.

Synthetic fabric jacket and silicone tube retain temperatures from upstream to downstream end

Made in continuous lengths up to 50′, this new Quaker hose easily withstands temperatures as high as +450°F; as low as −80°F.

As the above diagram shows, the hose keeps heat loss—and therefore energy loss—to a minimum. (Comparable outside temperature of ordinary hot air ducting material, such as stainless steel, would be about 400° F.). Both the silicone tube and the synthetic fabric jacket of Quaker's new hose hold the heat!

Other advantages? The hose is lightweight and fully flexible. And it resists abrasion.

Available in either single or double jacker, the hose comes in 1″ to 4″ I.D.'s. Sizes 1″ and 1¼″ I.D. can be made in 30′ continuous lengths; 1½″ to 4″ I.D. in 50′ lengths. The hose takes regular expansion and shank hose couplings.

H. K. Porter Company, Inc.,
Quaker Rubber Works,
Philadelphia 24, Pa.
Pioneer Works,
Pittsburg, Calif.

H. K. PORTER COMPANY, INC.
QUAKER RUBBER DIVISION

NAMES . . .

town, Pa., as economic evaluator, senior chemist and research engineer, respectively.

James M. Church, professor of chemical engineering at Columbia University, has been elected a director of Riverside Plastics Corp.

A. B. Chadwick

Velsicol Chemical Corp. has appointed A. B. Chadwick as director of manufacturing.

Chadwick earned a B.S. in chemical engineering at Lehigh University in 1939. Since that time, he has worked in supervisory and executive chemical manufacturing positions with Allied Chemical & Dye Corp., Pennsylvania Coal Products Co., and Koppers Co., Inc.

Two years of this period was spent in Sao Paulo, Brazil, where he served as plant manager of Cia. Brazileira de Plasticos Koppers. Then, just before he joined Velsicol, Chadwick was in charge of industrial engineering in Koppers' chemical division.

Howard R. Wilson has been appointed senior chemical engineer for process design at General Tire & Rubber Co., Akron, Ohio. Till now, Wilson had been a staff engineer with H. K. Ferguson Co.

John B. Lidstone has been appointed field representative for GE's chemical materials department in the Western New York area.

William C. Bedoit, Jr., is now manager of market develop-

ment for Jefferson Chemical's commercial development division, Houston, Tex.

Paul Estep has been appointed technical superintendent for the Niagara Falls plant of the potash division of International Minerals & Chemical Corp.

J. R. Callaway Brown has been promoted to scientific advisor at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Nathan P. Vahldieck has been appointed to the staff of the Tonawanda, N. Y., laboratories of the Linde Co., division of Union Carbide Corp. He'll work in the chemical engineering development section of the engineering laboratory.

Daniel McC. Collette

American Cyanamid Co. has named Daniel McC. Collette as plant manager of its plastics and resins division's Wallingford, Conn., plant.

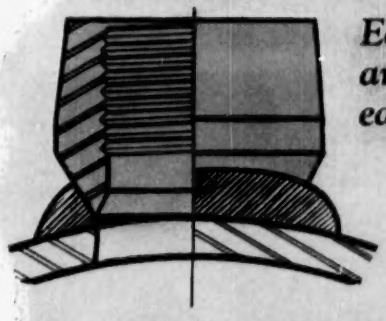
Formerly manager of the Niagara Falls, Ont., plant, Collette has also served as plant manager at Azusa, Calif. and as assistant general superintendent at Welland, Ont.

Collette graduated from Berea College in Kentucky and studied chemical engineering at the University of Virginia. He is a member of the AIChE.

Thomas E. Kopp has joined the production department of Monsanto Chemical's inorganic chemicals division in Trenton, Mich. **Roy G. Moore**

A New Line of Branch Connections

W-S COUPLETS



Economical and easy-to-install

Readily modified for small diameter installation

W-S Couplets are designed to function as universal outlet connections for tanks, process vessels and pipelines. They eliminate the need for large, expensive field inventories and costly delays in fabrication.

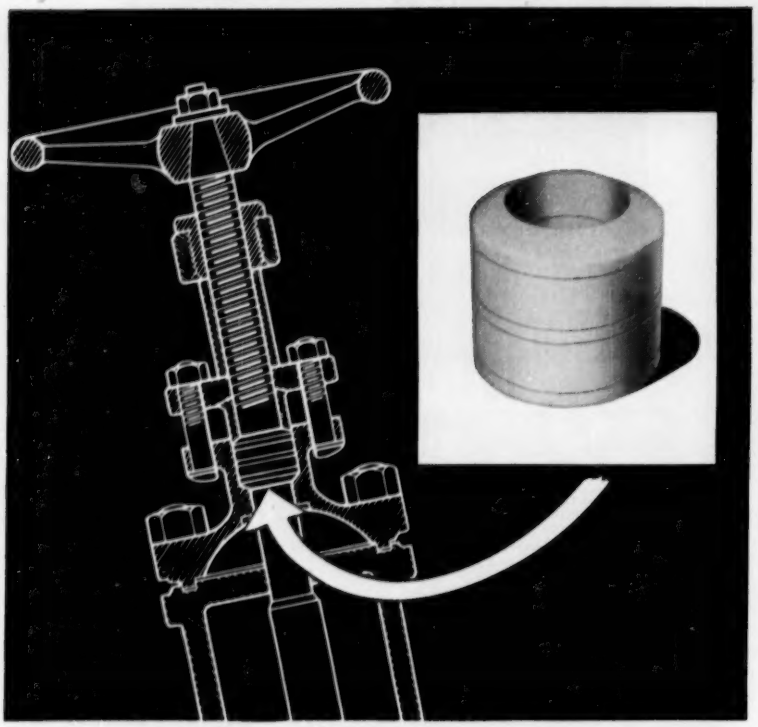
On most tank, and large piping installations they are used as received. On those few applications where attachment is to be made to a small diameter pipe, the W-S Couplet is easily modified by contouring the welding end with an acetylene torch to mate with the curvature of the pipe diameter. Couplets are made with extra length and heavy wall to permit contouring without detriment to the threaded or socket end.

W-S Couplets are available in sizes ¼" through 2", with screw-end or socket-welding dimensions . . . also in a 90° elbow.

Send for Bulletin CP-1-57. Write to W-S Fittings Division, H. K. Porter Company, Inc., P. O. Box 95, Roselle, N. J.

H. K. PORTER COMPANY, INC.

W-S FITTINGS DIVISION



R/M Teflon* PACKINGS

solve your difficult sealing problems

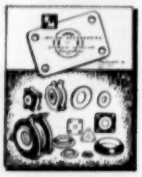
If corrosive liquids or extreme temperatures are causing you packing failures and contamination problems, you want R/M "Teflon" packings.

Chemically inert, R/M "Teflon" cannot be attacked by any known industrial acid, caustic or solvent. It withstands temperatures from —450° to 500°F.

R/M offers you the advantages of this unique resin in a complete line of solid, braided and plastic "Teflon" packings for all types of chemical and solvent service. R/M "Teflon" packings far outlast conventional materials, cutting your maintenance costs and reducing downtime. They will not contaminate any piped liquid.

Also available are R/M "Teflon" couplings; and "Teflon" bellows-type expansion joints with integrally gasketed flanges and special limit bolts.

Send for a booklet on R/M "Teflon" packings telling about pure "Teflon" types, "Teflon"-impregnated asbestos, and other combinations. Includes data on R/M "Teflon" ring and envelope gaskets.



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NAMES . . .

has joined the department at the firm's Carondelet plant in St. Louis.

B. C. Smith, resident manager of the Crown Zellerbach Corp. paper mill at Lebanon, Ore., has been promoted to manager of pulp production at Camas, Wash.

Dexter A. Smith

The board of directors of Bowen Engineering, Inc., has elected Dexter A. Smith as vice president.

Smith, a graduate of Purdue University, holds a B. S. and an M. S. in chemical engineering. He was first employed by Jos. E. Seagram & Sons in the research and production departments until 1942 when he joined Swenson Evaporator Co. In 1950, he advanced to become manager of the Swenson Spray Drying department.

A member of the AIChE, he served as chairman of the Chicago section for two years. He holds a professional engineer's license in the state of Illinois.

R. E. Tennery of Seattle, Wash., has been appointed general superintendent of Link-Belt Co.'s Los Angeles plant.

Lowell Technological Institute has just appointed **Melvin Mark,** professor in the department of textile engineering and **Fritz F. Kobayashi,** assistant professor of fibers and yarns.

Hilliard L. Williams, recent graduate of the University of Michigan, has joined the process design section of the

engineering department, organic chemicals division, in St. Louis, Mo.

Norman T. Shideler has been elected president of Insul-Mastic Inc., newly acquired subsidiary for the protective coatings division of Pittsburgh Coke & Chemical Co. **Arthur E. Gray** will succeed Shideler as the division's general manager.

James L. Kelley has been named superintendent of Pollock Paper Corp.'s waxed paper converting plant now under construction in San Jose, Calif.

Charles B. Breedlove, Ernest M. Skytta, F. Albert Smiles, and **Ralph T. Urich**—all general managers of various Reichhold Chemical plants—have been elected vice presidents of the company.

Joe M. Gafford

W. R. Grace & Co. has named Joe M. Gafford to head up the manufacturing department of its high density polyethylene plant to be operated shortly by the polymer chemicals division at Baton Rouge, La.

In his new post, Gafford will be responsible for production activities related to the manufacture of polyolefin resins.

Previously, he had been superintendent of the Pensacola, Fla., plant of Escambia Chemical Corp. Earlier in his career, Gafford was employed at the Louisville plant of the B. F. Goodrich Chemical Co. where he was general foreman-techni-

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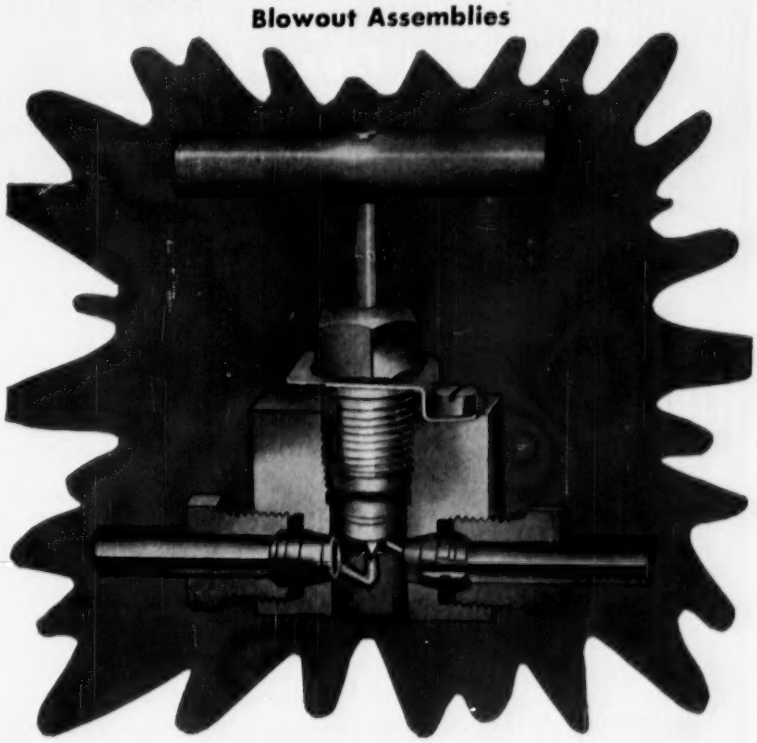

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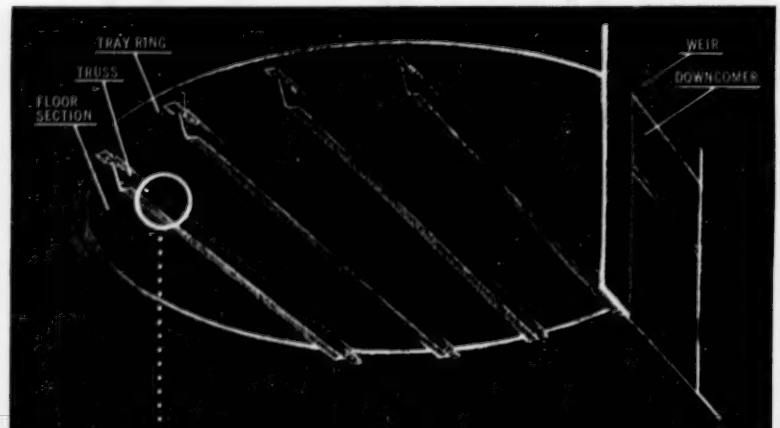

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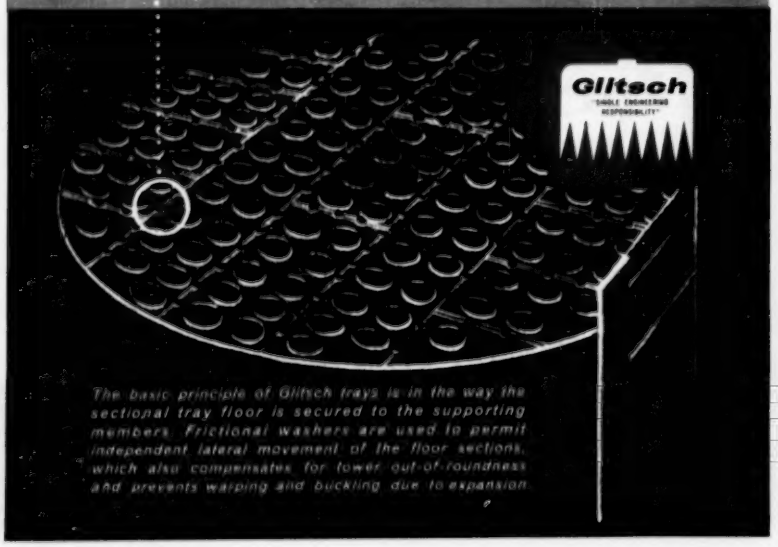
Lightweight Glitsch "Truss-Type"® Trays are comparable in first-costs to heavy plate trays, but when continued economy is considered these facts are significant: Glitsch trays allow use of lightweight alloys, yet provide maximum strength and rigidity for tray sections. Each tray can be installed and removed in sections through the tower manways. "Truss-Type"® Trays are simple in design and can be adapted to any process requirement, any flow type, vessel size, and layout, without sacrificing any features of installation or removability. In addition, when critical corrosion-resistant alloys are required throughout a new unit, Glitsch trays allow a wider distribution of the available materials.

Regardless of your requirements, "Truss-Type"® Trays will save you time and money in the long run. For full details, call your Glitsch representative and ask for a copy of our Catalog No. 150, or write to us at P. O. Box 6227, Dallas. There is no obligation, of course.



The basic principle of Glitsch trays is in the way the sectional tray floor is secured to the supporting members. Frictional washers are used to permit independent lateral movement of the floor sections, which also compensates for tower out-of-roundness and prevents warping and buckling due to expansion.

cal in charge of a polyvinyl chloride unit.

Gafford earned his degree in chemical engineering from Alabama Polytechnic Institute in 1940.

Francis J. Sergeys

W. R. Grace & Co. has appointed Francis J. Sergeys vice president in charge of development for its research and development division in New York.

Prior to joining Grace, Sergeys was general manager of chemical products research and development for Ethyl Corp. in Baton Rouge, La.

Sergeys earned a B. S. degree in chemical engineering from the University of Detroit in 1935 and an M. S. degree from the University of Michigan in 1940. He is a member of the AIChE and of the American Association for the Advancement of Science.

A. R. Downing is now manager of the spray dryer department of Swenson Evaporator Co., division of Whiting Corp., Chicago.

Elliott V. Nagle has been appointed an assistant technologist in the coal chemical division of U. S. Steel's applied research lab in Monroeville, Pa.

H. M. Johnson, Jr. has been appointed product manager—rubber—for Union Carbide Corp.'s silicones division. **J. H. Lorenz** is his assistant manager.

John J. McKetta, Jr., University of Texas chemical engineer-

ing department chairman, has been named to a two-year term on the board of trustees of Tri-State College, Angola, Ind.

Charles H. Atwood has been appointed president of Union Carbide Caribe, Inc., Puerto Rican subsidiary of Union Carbide Corp. which will operate a new petrochemicals plant now under construction.

Carl Ludwig has been made chief engineer of the engineered products division, Wellman Engineering Co., Cleveland.

J. Kenneth Koster

B. F. Goodrich Chemical Co. has appointed J. Kenneth Koster as manager of construction.

In his new post, Koster will supervise all new plant construction and major expansions of existing manufacturing facilities. Headquarters will be in Cleveland where the firm's general offices are located.

Formerly, Koster had been supervising engineer in charge of the construction of BFG Chemical's new plant in Henry, Ill. He has been in the firm's employ since 1940.

Koster attended Lamar College in Beaumont, Tex. and is a member of the AIChE.

Wallace H. Brown has been promoted to head chemist of the resin research section at United Central Research Laboratories, Chicago.

William L. Bolles, engineering department, Monsanto Chemical Co.'s Texas City, Tex.,

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plant, has been transferred to the Lion Oil Co.'s unit at El Dorado, Ark., as manager of process design and economics.

A. O. Zoss has been appointed manager of manufacturing administration, chemical products group, Minnesota Mining & Mfg. Co., St. Paul, Minn.

Robert L. Purvin

Leading consultant in the oil, gas and petrochemical industries—Robert L. Purvin—has been elected executive vice president of the Foster Grant Co., Leominster, Mass.

Purvin resigned as president and director of Purvin & Gertz, Inc., Dallas consultants, to accept the newly created position.

Before he took on consulting work, in 1945, Purvin had worked with the technical services division of Humble Oil & Refining Co.

A member of the AIChE, Purvin earned his chemical engineering degree at MIT in 1941.

Frederick H. Good, senior economist, has been appointed to Stanford Research Institute's European office in Zurich, Switzerland.

John J. Glover has been appointed manager of the commercial division of Jefferson Chemical Co., Inc. The newly created division combines market research and sales development operations.

Alfred C. Stepan, Jr., president and founder of Stepan Chem-

ical Co. has announced the acquisition of Ninol Laboratories, Inc., Chicago.

Harry F. Poll has joined Ehrhart & Associates, Inc., engineers and constructors, California, as process development manager. Headquarters will be set up in Los Angeles.

Stanley L. Krugman has been appointed vice president of Jacobs Engineering Co., Pasadena, Calif. Formerly, he had been chief engineer in charge of process and plant design.

Harry Litwin and **R. L. Huff** have set up a consulting engineering firm for the design and erection of process units. The new firm—Chem-Gas Engineers, Inc., is located in Houston.

Robert E. Frey has been appointed to the newly created position of assistant works manager for Diamond Alkali Co., Cleveland.

Donald S. Marshall has been appointed manager of the seed treating division of California Spray-Chemical Corp., Richmond, Calif.

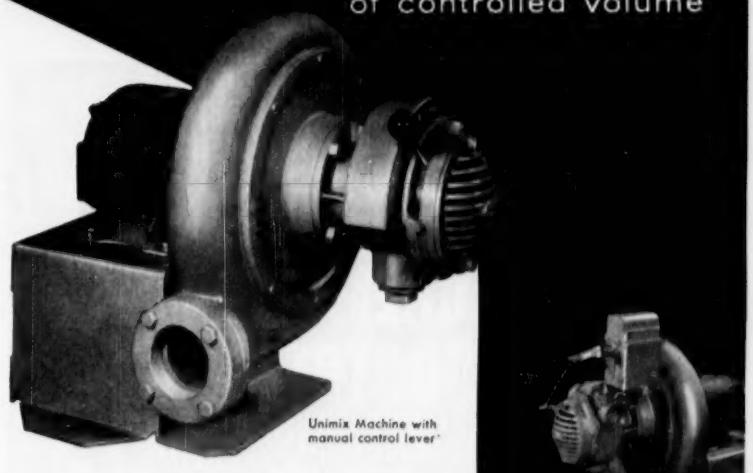
Stanley M. Norwood has been appointed assistant to the president of Electro Metallurgical Co., division of Union Carbide Corp., New York.

John W. Buskie has been elected a vice president of Tennessee Products & Chemical Corp. Since 1955, he has served as a vice president of Tenn-Tex Alloy & Chemical Corp., a subsidiary.

Ralph D. Webb, head of Union Carbide Chemicals' South Charleston, W. Va., plant has been elected to honorary membership in the Instrument Society of America.

Joe Hyer, production superintendent for Texas Butadiene & Chemical, has been named director of manufacturing; **Tom H. Pierson** is now director of engineering; **L. Hill Westmoreland** is plant manager in charge of operations at Lyondell, Tex.

NEW UNIMIX MACHINE
for uniform air gas mixture
throughout wide range
of controlled volume



Unimix Machine with manual control lever

New Eclipse Unimix Machine, with easily preset gas orifices, maintains constant gas-air ratio as the air valve is manually or automatically operated. *The principle* is foolproof — up to nine gas orifices in the manifold are simply uncovered, one at a time, as the air valve moves toward full-open position. To preset delivery from each orifice, simply screw in for less gas, out for more gas. Models are available with either manual or thermostatically controlled air valve operation.

A new low in noise level and easy adaptability to dusty air conditions are additional advantages. The Unimix Machine has the same low noise level as the blower alone. To install standard filters, simply unbolt the grid from the face of the segment-type air valve, insert filter, and replace grid. Models deliver air-gas mixtures for 800,000 to 2,350,000 Btu maximum burner input and 215,000 to 500,000 Btu minimum burner input. Write for details and specifications.

Eclipse

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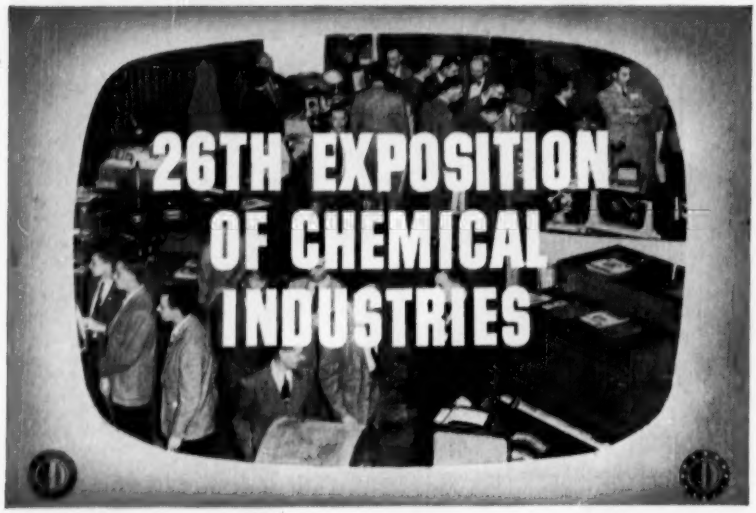

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NEW YORK COLISEUM, DECEMBER 2-6, 1957

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NAMES . . .

Maurice F. Dufour, a vice president of Freeport Sulphur Co., has been made responsible for the construction of the firm's $100 million nickel-cobalt project in Cuba.

Winston S. Peeler, a chemical engineer who joined American Oil Co. in Texas City, in 1934, has been elected vice president in charge of manufacturing.

Ralph R. Calaceto has been appointed manager and sales engineer of the process equipment division of Automotive Rubber Co., Inc., Detroit.

Charles B. Cooper has been named plant manager of B. F. Goodrich Chemical's new Henry, Ill., General Chemicals plant.

R. S. Manne has been promoted to senior chemical engineer in the research and development division, Humble Oil & Refining Co., Baytown, Tex.

W. E. Hanford, formerly vice president of the M. W. Kellogg Co. has been appointed by Olin Mathieson Chemical Corp. as assistant to the president for research and development. He'll be located in the New York office.

Arthur E. Humphrey has been promoted from assistant professor to associate professor of chemical engineering at the University of Pennsylvania.

Paul W. Edwards, St. Louis, has been named plant manager of Monsanto Chemical's Avon, Calif., plant. **Eugene Cutright** and **Don Mayo** have joined the production department at the Texas City, Tex., refinery.

Eugene P. Whitlow has been appointed chairman of the department of chemistry and chemical engineering at Southwest Research Institute, San Antonio, Tex.

Ralph H. Starrett will be the manager in charge of a products pipeline division that

will be based in Kansas City, Mo., by Standard Oil Co. (Ind.).

OBITUARIES

George G. Brown

Dean of the University of Michigan's College of Engineering, George Granger Brown, died August 26 after an illness of several months.

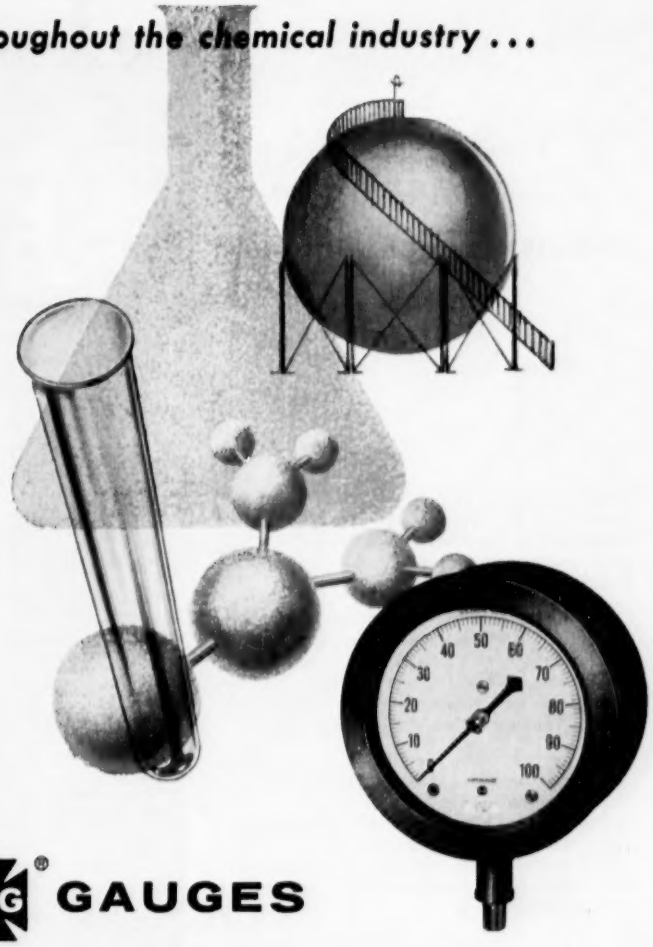
Though he began his career in industry—with the Aluminum Corp. of America as a research engineer—Brown soon chose the college campus. He joined the Michigan faculty in 1920 and became dean in 1951.

He was appointed director of the Atomic Energy Commission's engineering division in 1949 and was instrumental in establishing the first nuclear reactor in Michigan on the university's campus. The AIChE elected him president in 1944; some years earlier, he was recipient of the Institute's William H. Walker Award.

Irving Langmuir, a member of the General Electric research lab staff for over forty years, died August 16 at the age of 76. For his many accomplishments in the field of chemistry, Langmuir earned a Nobel Prize in 1932.

A. R. Nees, 72, retired research chemist for Great Western Sugar Co., died September 7, in Denver. Company officials say that its Johnstown, Colo, factory operations are based on more than a decade of research by Nees. The unit turns out monosodium glutamate from beet sugar by-products.

Throughout the chemical industry . . .



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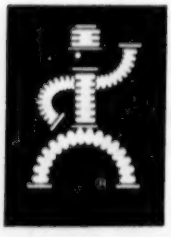

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PEOPLE . . . FIRMS IN

NEW LINES

I. Sonneborn Sons is now producing a new line of petroleum sulfonates under the name of Duonates.

Kimble Glass Co., subsidiary of Owens-Illinois Glass Co., is using a new hard borosilicate glass in company's line of Kimax laboratory glassware.

Inter Aircomb, AG., of Zurich, Switzerland, will be European manufacturer and marketer of Douglas Aircraft's Aircomb—a high-strength lightweight structural material.

Gulton Industries will produce the Laminagage—a tool for checking metal platings—under a General Motors patent.

National Plastic Products Co. has introduced a new high-molecular-weight polyethylene for vacuum forming. Name: Wynene Linear Polyethylene sheeting.

Velsicol Chemical Corp. will produce ethyl-parathion insecticide at its Memphis, Tenn., plant.

NEW LOCATIONS

Robertshaw-Fulton Controls Co. has shifted its executive offices to 911 E. Broad St., Richmond 19, Va.

NEW NAMES

Groma Metal Corp. is the new name of Groma Trading Corp., suppliers and technical consultants on the rarer metals.

Roche Laboratories, a division of Hoffman-LaRoche Inc., is the new title of Hoffman-LaRoche Inc.'s pharmaceutical division.

Eastern States Petroleum & Chemical Corp. has been adopted as the new name for

THE NEWS

J. B. BACON

the former Eastern States Petroleum Co. because of company's increasing activity in the petrochemical field.

NEW FACILITIES

Humble Oil & Refining Co.'s refining research and development division has a newly completed 27,000-sq-ft extension to its main laboratory building at the Baytown, Tex., research center.

Celgar Development Co., a Canadian Chemical & Cellulose subsidiary, has called for bids on preparatory construction work for company's planned Castlegar, British Columbia, pulp mill. Mill will cost $30 million, will have 300-ton/day output.

L. Sonneborn Sons will expand its Petrolia, Pa., microcrystalline wax plant to include facilities for the manufacture of oxidized microcrystalline waxes.

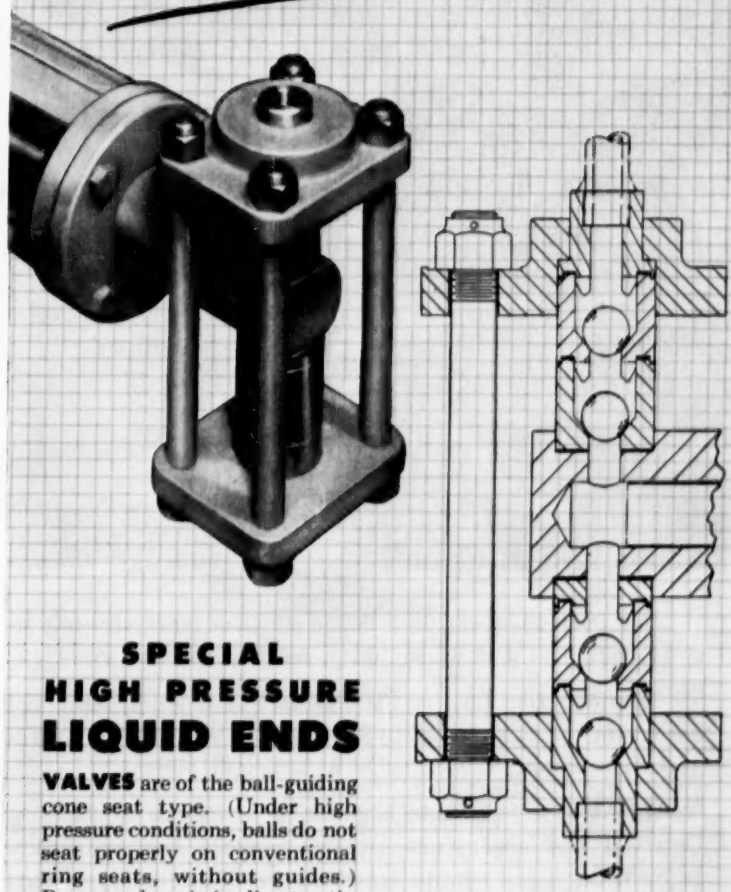
Titan Chemical Industries has started production at its Colorado Springs, Colo., aerosol manufacturing plant. Titan's brand of shaving cream and anti-static fabric spray are its first products.

Texas Portland Cement Co. is starting a $3.8-million expansion of its Echo, Tex., plant, upping cement capacity to 5,000 bbl./day.

Pennsalt Chemicals Corp. expects to have its first Canadian plant completed in December. Located near Oakville, Ont., plant will produce metal processing chemicals and other Pennsalt and Sharples products for marketing in eastern Canada.

American Machine & Metals has purchased the name and certain assets of Rahm Instruments, Inc., aircraft instrument makers. AM&M also has a long-term lease on Rahm's Westbury, N. Y., manufacturing facilities.

advanced design in high pressure pumps



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VALVES are of the ball-guiding cone seat type. (Under high pressure conditions, balls do not seat properly on conventional ring seats, without guides.) Pressure drop is in direct ratio to ball rise. Valves are machined from solid stainless steel bar. Balls are hardened and ground stainless steel. They may be spring-loaded for down-stream pumping and viscous materials (up to 30,000 SSU).

HEADS are forgings or castings, depending upon size.

PISTONS are highly polished stainless steel or ceramic, ground and polished, as required.

PACKING is contained in the gland, *not divided*. Gland take-up is a screwed nut rather than a lantern flange, insuring even pressure on packing—*no cocking*.

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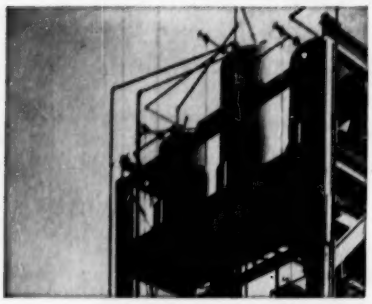

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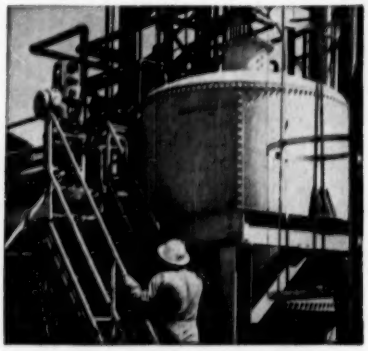

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has a long-term lease on Rahm's Westbury, N. Y., manufacturing facilities.

Norwich Pharmacal Co. is adding four new buildings—a total of 13,000 sq. ft. of plant space—to its manufacturing facilities at Norwich, N. Y. Cost: approximately $350,000.

Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp., is expanding production capacity to meet demand for its Emulsifiable A-C Polyethylene used primarily in polishes.

American Lava Co., subsidiary of Minnesota Mining & Mfg. Co., is planning a 7,000-sq.-ft. pilot plant for producing ceramic fuel elements for nuclear power reactors.

Aluminum Co. of America is consolidating its research in the field of aluminum foil with new research facilities to be located at New Kensington, Pa.

Daystrom Inc.'s systems division will build an advanced automation research lab in the La Jolla, Calif., area. First section of 30,000 sq. ft. is slated for early 1958 completion.

Foster Grant Co. will spend $5.4 million expanding its plastics production. Output at the Baton Rouge, La., styrene monomer plant will be upped to 105 million lb./yr.; polystyrene, nylon and plastic molding facilities are also slated for expansion.

Cleveland Automatic Machine Co. has acquired all rights for manufacture and sale of Hy-R-Speed Mills, grinding mills used in paint, chemical and food industries.

Research Specialities Co., manufacture of radiochemicals, has purchased all the assets of Cal-Rad Laboratories of Los Angeles, Calif.

National Can Corp. has purchased a 175,000-sq.-ft. can manufacturing plant from

Consolidated Food Corp. Output of the Cambridge, Md., plant is more than 3 million cans per day.

Sylvania Electric Products is adding a 34,000-sq-ft. wing to its physics laboratory at Bayside, N. Y. Wing should be finished by summer of 1958 at cost of $1 million.

Diamond Match Co. has made the first delivery of molded-pulp egg cartons from its Red Bluff, Calif., forest products plant. When totally finished in July, 1958, plant will have capacity of 350,000 molded cartons per day.

Hercules Powder Co. is expanding production capacity at its Kenvil, N. J., plant for manufacturing gas-generating cartridges. Completion is scheduled for early 1958.

Armstrong Cork Co. will add a one-story building and new equipment to the Armaflex facilities at South Braintree, Mass. Armaflex is a foamed-plastic insulating material.

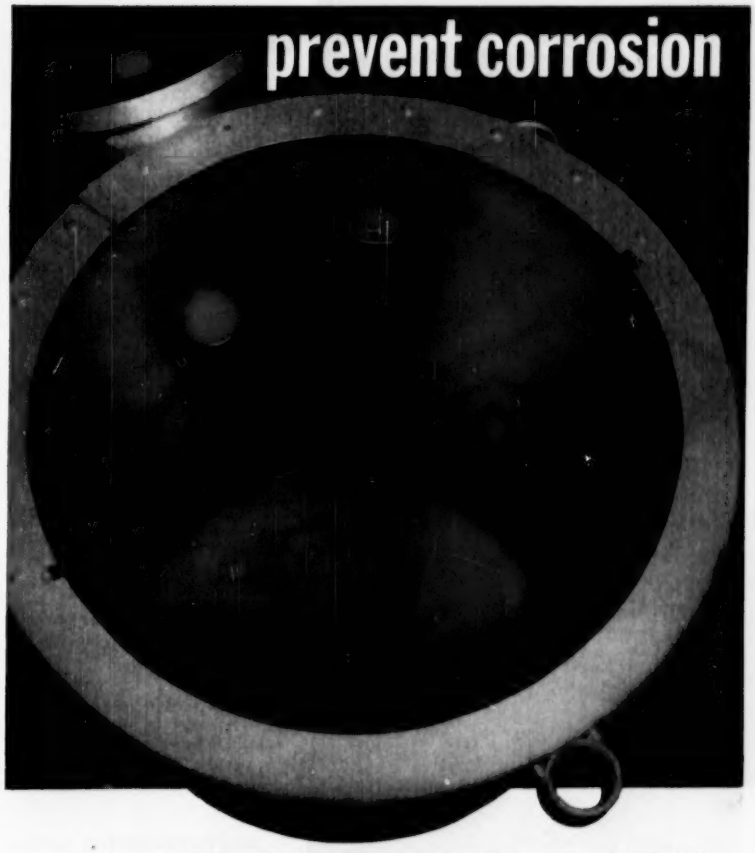
Emkay Chemical Co., chemical specialties manufacturer, is adding 4,000 sq. ft. to its Elizabeth, N. J., plant for use as warehouse space.

Harvey Aluminum's new reduction plant at The Dalles, Ore., is slated to be in partial operation in early 1958. Plant will eventually produce 108 million lb./yr. aluminum from over 100,000 ton/yr. alumina shipped from Japan.

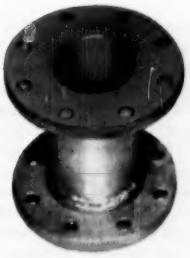
Timken Roller Bearing Co. has set June 1, 1958, as target date for installation of a new $500,000 vacuum electric furnace. Capacity: 5 million lb./yr. of high quality steel.

Bjorksten Research Laboratories has opened a 6,500-sq.-ft. research lab in Houston, Tex., will conduct sponsored research for industry in the Southwest.

American Cyanamid Co. has acquired the business and assets of the MacGregor In-



. . . with KEL-F LAMINATE linings



From a reactor pot to a tank truck—KEL-F* Laminate linings offer the way to make any ordinary equipment and piping extremely resistant to acids, alkalies, oxidants and solvents at temperatures up to 350°F—and at reasonable cost.

KEL-F Laminate, Garlock style No. 9574, is a durable, shatterproof, abrasion resistant, chemically inert fluorocarbon plastic, bonded to a glass-cloth backing for maximum adhesion. It is readily cemented over any contour and to any material of construction—metal, wood, concrete, etc. KEL-F being a thermoplastic resin, seams may be "welded", on the job by the thermal pulse technique, into a continuous chemically-impregnable lining.

CERTIFIED APPLICATORS—KEL-F Laminates are manufactured by the United States Gasket Company, pioneers and leaders in fluorocarbon plastics, and are available for installation by certified applicators.

Write for Bulletin AD-152.

UNITED STATES GASKET COMPANY
Camden 1, New Jersey

*Minn. Mining & Mfg. Co. Trademark

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

HOW *Cambridge* **Woven Wire Belts speed processing, cut costs**

Slab, sheet, pelletized and coarse granular materials can be continuously washed, dried, heated or cooled while moving on woven wire conveyor belts. Operations proceed rapidly and uniformly under perfect control without manual handling. Packaging, weighing and sealing, too, become continuous production-line steps as moving belt carries packages past these stations. EXAMPLE:

Continuous Washing

MOVING BELT carries granular material continuously through hot water spray rinse.

OPEN MESH permits rapid drainage of rinse water and free circulation of cooling and drying air, yet the belt can be woven densely enough to retain small particles.

ALL-METAL BELT of corrosion resistant alloy is impervious to damage from heat or process solutions, even many acids and alkalis. Woven wire construction eliminates seams, lacers and fasteners that ordinarily wear and break.

SPECIAL RAISED EDGES hold material on belt, are typical of variety of side and surface attachments available to hold even the smallest size product during flat or inclined travel.

Cambridge Woven Wire Conveyor Belts are made in any size, mesh or weave, from any metal or alloy, and can be used under a wide range of conditions . . . from 2100°F. to sub-zero, wet or dry. Call your Cambridge Field Engineer to discuss how you can speed production and cut costs with continuous processing on woven wire conveyor belt. Look for his 'phone number under "Belting, Mechanical" in the Yellow Pages or write for FREE 130 PAGE REFERENCE MANUAL.

The Cambridge Wire Cloth Co.

Department G, Cambridge 11, Maryland

WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

FIRMS . . .

strument Co., makers of hypodermic needles and syringes, located in Needham, Mass.

Lynch Corp. has purchased Robbins Plastic Machinery Corp. of Elkhart, Ind. Acquisition is part of a Lynch program to diversify in field of automatic processing equipment.

Warren Corp., builders of industrial and medical laboratory equipment, has opened a new Lustra Line Div. plant at Clarion, Pa.

Olin Mathieson Chemical Corp. will erect a small plant near Montville, Conn., for the assembly of nuclear reactor cores. Completion is set for spring of 1958. Company has also started construction on a $36-million plant to make boron-based, liquid high-energy fuels near Niagara Falls, N. Y.

Du Pont of Canada plans to erect a linear polyethylene plant just south of Sarnia, Ont. Plant will have facilities for polymerization and for compounding of the finished product.

National Petro-Chemicals Corp. plans a $20-$25-million polyethylene resins plant in the Gulf Coast area. New unit will add 75 million lb./yr. to National's present capacity of 100 million lb./yr.

Spray Engineering Co. has moved into a new Burlington, Mass., plant. Plant combines 30,000 sq. ft. of manufacturing space with 6,000 sq. ft. of office area.

DeMert & Dougherty, Inc.'s subsidiary, Mid-America Chemical Terminal, has purchased the Chicago plant of U.S. Industrial Chemicals Co. Manufacturing area will accommodate aerosol line of products.

Westvaco Mineral Products Div. of Food Machinery and Chemical Corp. has just completed a major expansion of phosphoric acid and phosphate fa-

cilities at its Newark, Calif., plant. Expansion doubles Westvaco's phosphate capacity at Newark.

Harbison-Walker Refractories Co. has started construction of an integrated research center on a 21-acre site south of Pittsburgh, Pa. Employing about 100 people, the 45,000-sq-ft. center will be devoted to work on highly refractory materials.

Fuller Co., subsidiary of General American Transportation Corp., has entered the field of dust collection and recovery by the purchase of Dracco Corp., maker of dust collection equipment, Cleveland, Ohio.

American Marietta Co. has acquired Booty Resineers, Inc., of Newark, Ohio. To be operated as a division of American-Marietta, Booty Resineers manufactures wide line of resin products.

Victor Chemical Works has purchased a phosphate ore washing plant and 2,700 acres of phosphate land previously owned by Federal Chemical Co., near Mount Pleasant, Tenn. Acquisition will supply Victor's Mount Pleasant electric furnace plant with raw material.

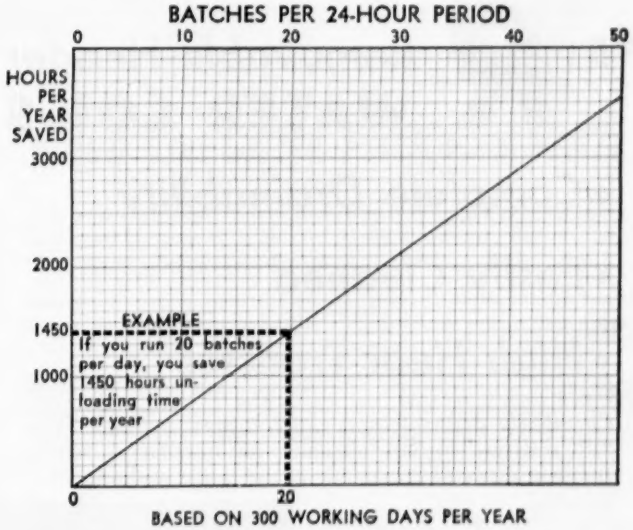
A. R. Maas Chemical Co., division of Victor Chemical Works, has started construction of a phosphoric acid and catalyst plant at Richmond, Calif.; initial production is expected in early 1958.

Union Carbide Ltd. is building a $8.4-million petrochemical plant at Fawley, in Hampshire, Eng. Scheduled for completion by 1959, plant will convert ethylene to a number of ethylene oxide derivatives. Esso Petroleum Co. Ltd. will supply the ethylene from its nearby $25-million plant.

Steelman Gas Ltd. will erect a $20-million casing-head gas processing plant northeast of Estevan, Sask. Plant will produce 25 million cu. ft./day of

PREDICT the centrifuging hours you save in a year

This most revealing chart quickly shows how much unloading time you can actually save, with Batch-Master's rapid bottom discharge and hydraulic unloader. The chart is based on Batch-Master's unloading time (30 seconds average) . . . as compared with that of a manually unloaded batch centrifugal (15 minutes or more). If the chart gives you a jolt, investigate Batch-Master.



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Tolhurst CENTRIFUGALS

A DIVISION OF

American Machine and Metals, Inc.

Specialists in liquid-solids separation

Dept. CET-1157, EAST MOLINE, ILLINOIS

Send me your catalog on the time-saving Batch-Master Centrifugal.

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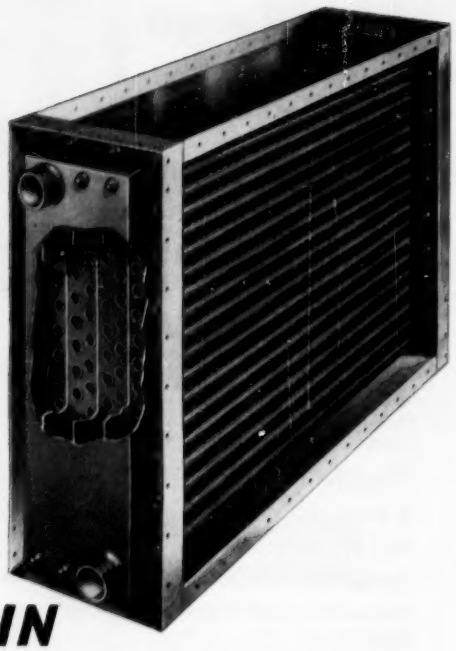


AEROFIN

TYPE R Removable-Header WATER COILS

- Complete Drainability
- Easily Cleaned
- High Heat Transfer

Completely drainable and easily cleaned, Aerofin Type "R" coils are specially designed for installations where frequent mechanical cleaning of the inside of the tubes is required.

The use of ⅝" O.D. tubes permits the coil to drain completely through the water and drain connections and, in installations where sediment is a problem, the coil can be pitched in either direction. The simple removal of a single gasketed plate at each end of the coil exposes every tube, and makes thorough cleaning possible from either end.

The finned tubes are staggered in the direction of air flow, resulting in maximum heat transfer. Casings are standardized for easy installation.

Write for Bulletin No. R-50

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N.Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

propane, butane, natural gasoline, sulfur and dry residual gas.

International Minerals & Chemical Corp. plans to spend $20 million constructing a modern potash mine near Esterhazy, Sask. Mine will employ 100-150 persons when completed; construction has already started.

African Explosives & Chemical Industries, subsidiary of Imperial Chemical Industries, is building a 150-ton/day nitric acid plant to be integrated with exising facilities at Johannesburg, South Africa.

California Spray-Chemical Corp. has opened a new quality control lab at company's recently completed $16-million fertilizer plant in Richmond, Calif.

California Oil Co.'s Perth Amboy, N. J., refinery will have two new gasoline redistillation towers for production of top-octane fuel and normal hexane by year's end. Capacity of the units: 9,700 bbl./day.

Du Pont Co. has completed final links in nation-wide chain of marine storage facilities for methanol, with new storage depots at Bay City, Mich., and Toledo, Ohio to supply the Great Lakes industrial complex.

G. S. Ziegler & Co. has built a 10,000-sq. ft. air-conditioned one-story office building in Great Neck, N. Y., to house its general offices.

Jefferson Chemical Co. has formed a new division to market the output of caustic soda from company's new chlorine plant at Port Neches, Tex., slated for completion late in 1958.

Texas Eastern Transmision Corp. is now receiving 115 million cu. ft./day of natural gas from Mexico through a 30-in. pipeline that cost $44 million. Gas, supplied by Petroleos Mexicanos, will be

transmitted through Texas Eastern's system extending through the central U. S. and terminating near New York.

Ampco Metal Inc., producer of aluminum bronzes, is adding a $200,000 branch foundry at Garland, Tex. The 15,000-sq. ft. plant is slated for operation by March, 1958.

Tracerlab, Inc., has established a wholly owned subsidiary in Amsterdam, Holland. Known as Tracerlab (Holland) N. V., subsidiary will market Tracerlab instruments.

Westinghouse Electric Corp. has announced an expansion of its Cheswick, Pa., facilities for manufacture of core components and assemblies for nuclear reactors. Plans call for a 24,000-sq.-ft. extension of manufacturing space.

Krupp Kohlechemie, jointly with Steinkohlenbergwerk Hannover-Hanniba1, has started ammonia production in a new plant at Wanne-Eickel in the Ruhr.

Boise-Cascade Corp. is planning a 150-ton/day pulp and paper mill at Walla Walla, Wash.

Linde Co. is boosting liquid oxygen and nitrogen capacity at its Fontana, Calif., plant by more than 140 tons/day. Expansion will bring capacity to about 430 tons/day.

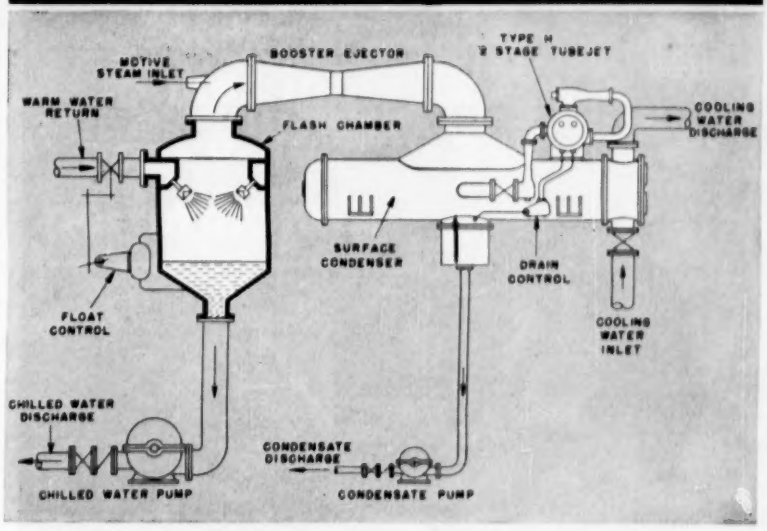
Hercules Powder Co. has started construction on a 10,000-ton/yr. urea plant at Hercules, Calif. New facilities are scheduled for completion by late 1958.

California Spray Chemical Corp. has expanded its Rocky Mountain sales and distribution facilities with a new headquarters at Salt Lake City, Utah.

Crinoplast, Inc., specializing in pharmaceuticals, has opened a new branch office in New York.

Nangal Fertilizers & Chemicals, a government-sponsored firm,

Save money 2 ways



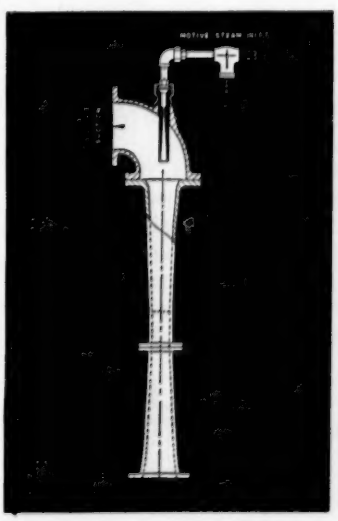
Above schematic diagram shows Wheeler Jet Vacuum Refrigeration Unit with surface condenser. Unit is easily adapted to low level jet or barometric jet condensers.

when you CHILL PROCESS WATER

C. H. Wheeler Steam Jet Vacuum Refrigeration operates at exceptionally low cost because it uses low pressure exhaust steam—steam that would otherwise be wasted in your processing plant.

Maintenance costs are unusually low, too, because there are no moving parts, except for those in the chilled water pump. No noise or vibration, either, with Wheeler Steam Vacuum Refrigeration.

It's an ideal refrigeration system for any application requiring chilled water temperatures of from 35° to 65°F. Wheeler Jet Vacuum Refrigeration has proved itself time after time in the chemical, food and process industries.



See your representative or write direct to C. H. Wheeler of Philadelphia for complete information.

Wheeler "Tubejet"* Booster Ejectors withdraw vapors at high vacuum, and discharge them to a lower vacuum in the condenser. Air and non-condensable vapors are removed from the condenser by a two-stage Wheeler "Tubejet".

Process Equipment Division

C. H. Wheeler Mfg. Co.

19TH & LEHIGH AVENUE
Philadelphia 32, Pennsylvania

Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Marine Auxiliary Machinery • Nuclear Products

Atlas CORROSIONEERED CONSTRUCTION gives you the plus beyond the price

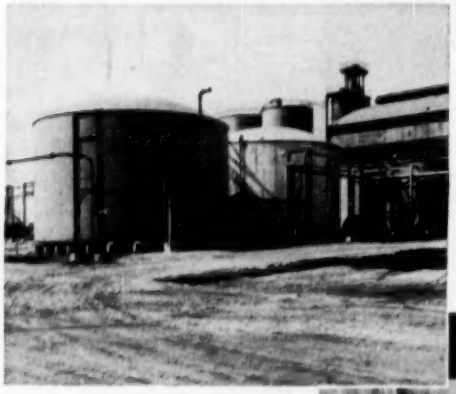


photo on left showing two large phosphoric acid tanks.

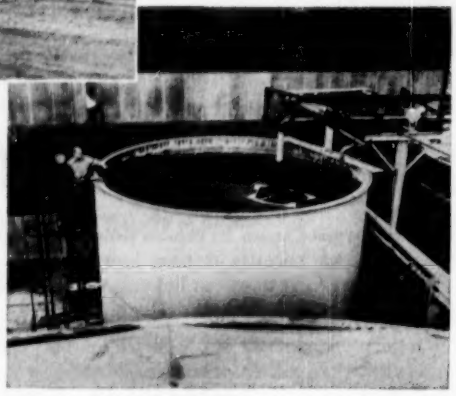


photo on right showing one of two 50% sulfuric acid tanks.

The above photographs picture a recent Atlas installation at the U.S. Industrial Chemicals Co., Div. of National Distillers Products Corp., at Tuscola, Illinois. This type of construction is typical of the "Plant-Wide" corrosion protection service that Atlas offers to the Chemical Industry.

The above installation consisted of two tanks for 50% hot sulfuric acid and two tanks for phosphoric acid. All work was done by Atlas crews at the job site.

Yes, there is a big plus beyond the price when you specify Atlas, only then will you get a completely integrated construction service, one that will accept full and sole responsibility for your job and will guarantee every aspect of it. This unique service is available to your industry, anywhere in the world, for new plant construction, expansion or maintenance work. Whatever the requirements, Atlas can and will do it right and on time.

Avail yourself of the complete facts today. Write for Bulletin CC-3.

ATLAS MINERAL
MERTZTOWN, PENNSYLVANIA

FIRMS . . .

is building a new fertilizer plant on Trombay Island near Bombay, India. Vitro Engineering is technical consultant.

Alaska Lumber & Pulp Co. has started construction on a $55-million pulp mill at Sitka, Alaska.

Sulfuros de Morelia has completed a new $280,000 sulfuric acid plant near Morelia, about 170 mi. west of Mexico City.

American Machine & Metals Co. plans to expand its U. S. Gauge Div. facilities at Sellersville, Pa., spending $2.5 million for a new plant near the present site.

Flintkote Co. has acquired Kosmos Portland Cement Co. of Louisville, Ky.; production at the Kosmos plant runs around 2 million bbl./yr.

Timken Roller Bearing Co. is going ahead with construction on a $1.5-million bearing plant in Ballarat, Australia, near Melbourne. The 30,000-sq.-ft. plant's output of 1 million bearings yr. will be supplemented with shipments from the U. S.

Chas. Pfizer & Co. has acquired Morton-Withers Chemical Co., chemical-specialties maker for petroleum, rubber and plastics industries.

Standard Chemical Products has awarded a contract to J. A. Jones Construction Co., Charlotte, N. C., for construction of additional laboratory facilities costing roughly $100,000.

Sylvania-Corning Nuclear Corp. has been contracted by Brookhaven National Laboratory to supply 5,000 nuclear fuel elements for Brookhaven's research reactor. Contract cost: about $250,000.

Plax Corp. has acquired new facilities at Ligonier, Ind., for producing polyethylene tubing, blow-molded containers and Polyflex oriented

polystyrene film and sheet. Production will start in early 1958.

Arthur C. Trask Co., Chicago manufacturer of tanning extracts and specialty chemicals has opened an eastern office in New York.

NEW REPRESENTATIVES

Wilson Petrolcoke & Carbon Corp., New York, N. Y., is the sales representative for the new metallurgical coke produced by American Gilsonite's Fruita, Colo., refinery.

Air & Hydraulic Equipment Co. is now the stocking distributor for Asco solenoid valves produced by Automatic Switch Co.

NEW COMPANIES

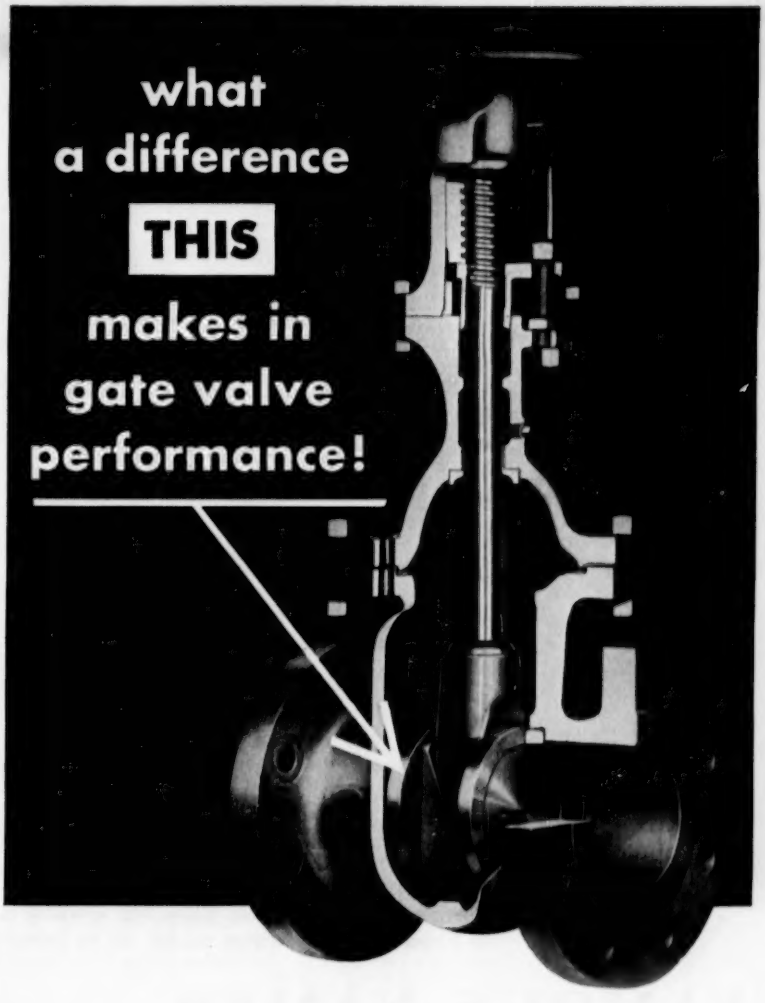
W. P. Fuller & Co., de Mexico, S. A., a new Mexican manufacturing firm, has been established with Mexican and American capital to produce house paint and consumer products from a plant in Ensenada, Baja California.

Alberta & Southern Gas Ltd. has ben set up as a wholly owned Pacific Gas & Electric Co. subsidiary to purchase surplus Canadian natural gas for the California market.

Controls for Radiation, Inc., has been established with headquarters in Cambridge, Mass., to provide a comprehensive service covering radiation safety and hazards control aspects of the nuclear industry.

Archer-Daniels-Midland Co. has formed Scado-Archer-Daniels GmbH, with a plant in Ruehle near Meppen, Lower Saxony, to produce softeners and alkyd resins.

Air Engineering Co. emerges as the principal firm in a merger of Marshall & Wells Co. and Air Engineering Co. New company's offices will be in Kalamazoo, Mich.



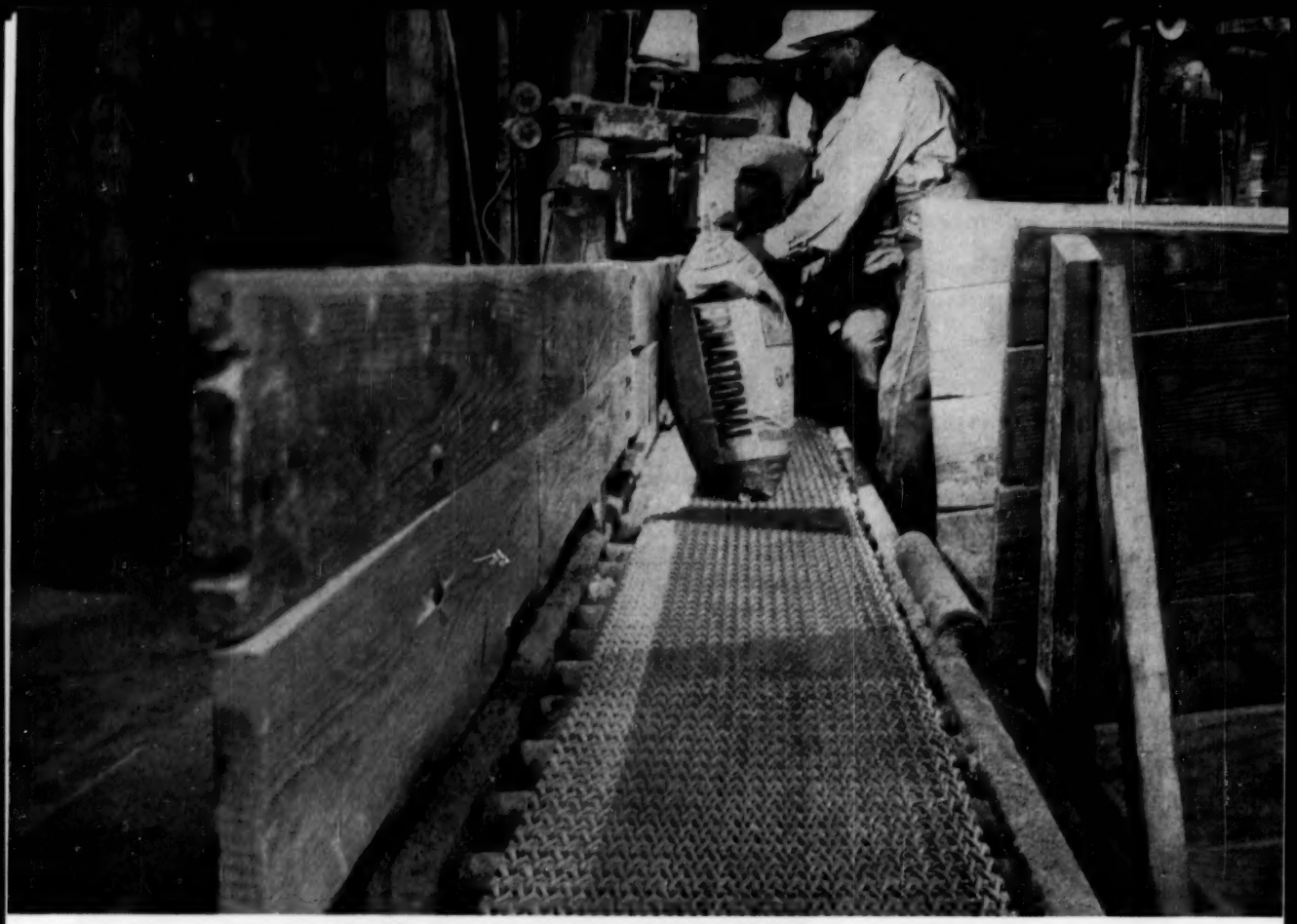
LONGER valve life, less maintenance and process interruption, positive closure, easier operation, self-adjustment for valve body deflection. These are some of the well proved advantages gained as a result of the Darling *fully revolving double disc parallel seat* principle!

These Darling valves are made in various alloys, types and sizes for most services . . . and for all pressures. Send for Catalog No. 57. You'll see what we mean by exceptional performance.

ENGINEERING SERVICE: Darling offers unusual facilities for the development and manufacture of special valves for out-of-the-ordinary requirements. This special service is available to you at all times, without obligation.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.
Manufactured in Canada by
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING
DARLING
VALVES



With present system, including Wissco Belts operating at 34.3 fpm, 18 tons of 50-pound bags of fertilizer powder can be loaded in only 25 minutes.

FAMOUS NAMES
ride on WISSCO BELTS

International Minerals & Chemical Corporation

The story of Wissco Belts is best told by their users. For instance, Mr. T. L. Holland, production superintendent of the Tupelo, Mississippi Plant Food Division of International Minerals and Chemical Corporation, says:

"Our Wissco Belts have eliminated bag breakage, increased conveyor life by 300%, reduced conveyor maintenance and replacement costs by as much as $10.00 per lineal foot!"

The belts convey paper sacks of fertilizer from the open mouth bagging machines to a machine which sews them shut, then on to a central conveyor leading to the loading platform. New developments which increased the speed of bagging operations rendered the original pentle chains with wooden slats impractical. The bags were catching between the slats and were being torn open.

"We were losing almost 20% of our bags", Mr. Holland explained. Conversion to a 6-belt C-section V-belt eliminated bag losses and permitted capacity-speed operations, but by the end of the first bagging season, the V-belt conveyor was worn out, needed replacement. Then, in the fall of 1954, the first Wissco Belt was installed. "The initial cost of the Wissco Belt was lower than that of any other conveyor we could use", Mr. Holland continued, " . . . only $2.00 per lineal foot as compared to $3.80 for slatted belts, and $4.80 for C-section V-belt. And, consider the life-factor . . . a minimum of three years life on the Wissco Belts vs. a maximum of one year on V-belts and two years on slatted conveyors. The Wissco Belts have withstood corrosion and rough handling without regular cleanups or repairs, are in constant operation during rush months, required only 10 minutes down time during the past season, have performed better than any other conveyor we have seen or heard of."

Economy . . . minimum maintenance . . . long service life . . . outstanding performance—factors that improve profits from any processing and conveying operation. Put them to work in yours. Contact the sales office nearest you for complete information on Wissco Belts.

THE COLORADO FUEL AND IRON CORPORATION • Denver and Oakland
WICKWIRE SPENCER STEEL DIVISION • Atlanta • Boston • Buffalo • Chicago
Detroit • New Orleans • New York • Philadelphia
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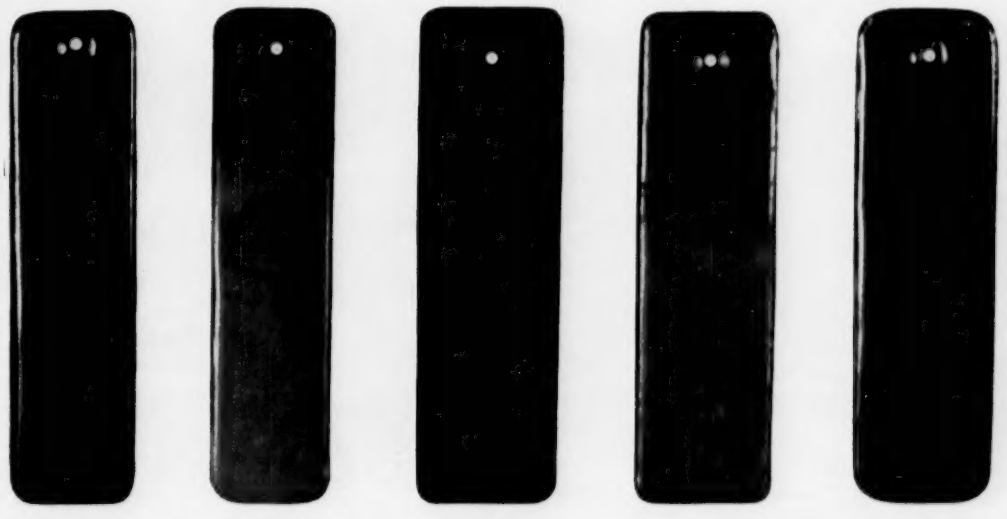
5431

WISSCO BELTS
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

CF&I

Look for results like this when you test TARSET® immersion panels!



5% Sodium Hydroxide after 490 DAYS

20% Sulphuric Acid after 422 DAYS

10% Nitric Acid after 487 DAYS

5% Hydrochloric Acid after 490 DAYS

3% Sodium Chloride after 487 DAYS

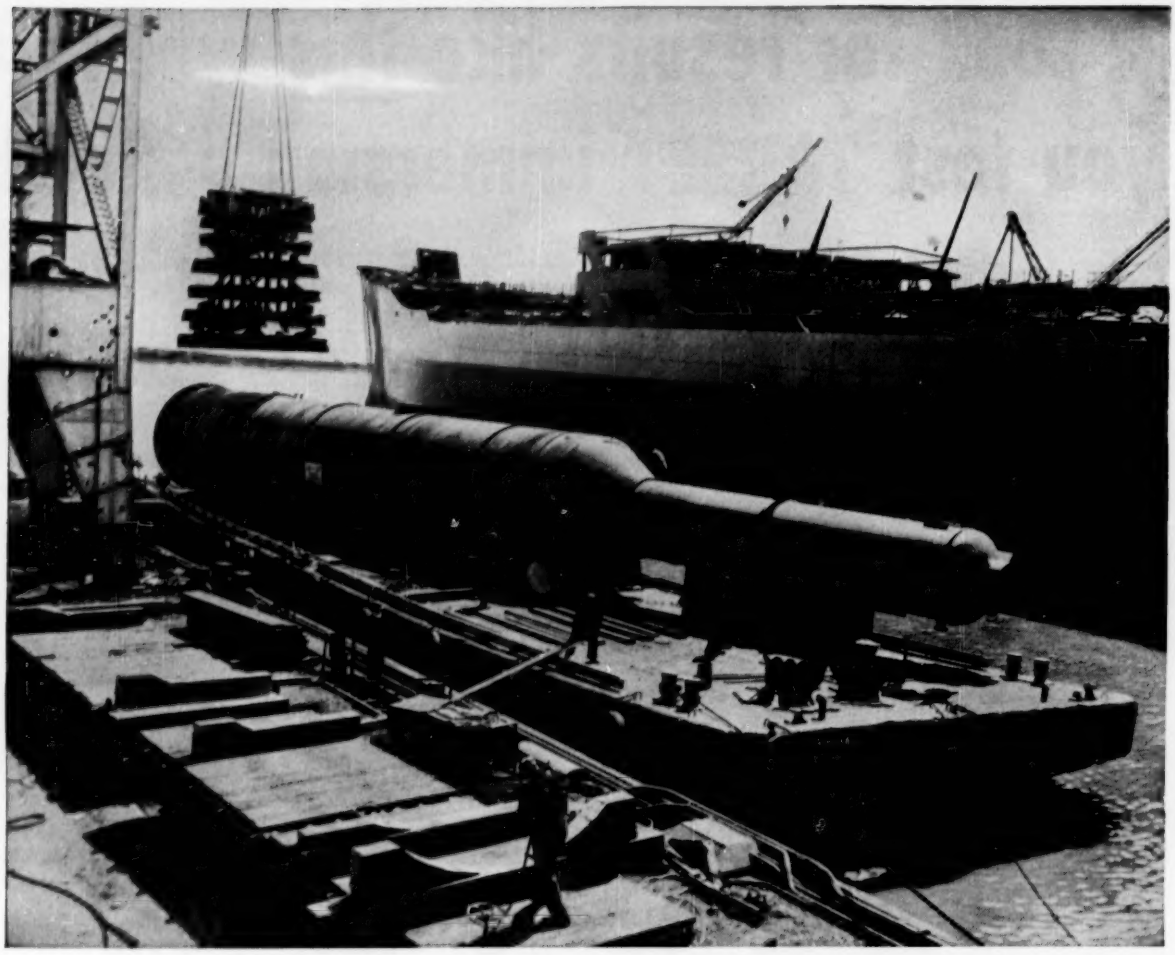
THE unretouched photographs above tell their own dramatic story about the ability of Pitt Chem *Tarset* to resist chemical corrosion! In each case, the test panel was removed from the immersion vessel, rinsed under cold water, wiped lightly and photographed. Several of the panels exhibited slight staining. But *none* of the panels showed any perceptible effect of the reagents on the *Tarset* coating!

Tarset is the patented coal tar-epoxy resin coating backed by *three years of service experience.* Chances are it's the *one* coating that can solve many of your toughest chemical corrosion problems . . . at a relatively economical cost.

If you have a stubborn corrosion problem in your plant, we invite you to investigate *Tarset* today. We will be glad to send you immersion performance data . . . and any other technical information you may need.

WBW 6771

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON



standard procedure: VERSATILITY...

The variety of work which Sun Ship's integrated shops produce for use by industries on land and sea brings a matching variety of shipping problems.

Our facilities for tidewater shipment are used to economical advantage on many of the massive structures that go into the making of the nation's petroleum and chemical industries. The barge shipment of tower and shed row baffles, shown above, is a good example.

And of course—when shipment by land is necessary—Sun Ship rigging and routing find the ways and means to handle such items as large-diameter columns by rail and truck.

It's all a part of the versatility which forty years' experience has made part of "standard procedure" in service of its customers.

Our Sales Engineering Department would be glad to use its experience in helping you overcome any problem of construction or shipment that faces you. Write

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE SINCE 1916 CHESTER, PA.

SCRUBOSPHERE* ...

FOR *Cleaner Gas* AT *Less Cost!*

*PEERLESS SPHERICAL DUST and LIQUID SCRUBBER FOR GAS PIPELINES

- The **dust removal ability** of the SCRUBOSPHERE **is superior** because it utilizes wetted surfaces for dust collection which are much more closely spaced than in conventional equipment.
- **Oil loss is minimized** because the oil used to wet the dust collecting surface is lifted mechanically instead of bubbling gas through the oil which results in foaming and loss due to creation of hard-to-separate fine particles.
- **Maximum performance and low cost** — The spherical design means high capacity and performance because it provides maximum dimensions for the contactor and mist extractor which normally are limiting factors in scrubber designs. The vessel cost is reduced because required vessel thickness is only one half that required for cylindrical vessel of same diameter.
- **Versatility** — separates solid and liquid particles with equal efficiency.
- **Low pressure drop** — ½ to ¾ psi at rated capacity depending on nozzle size.

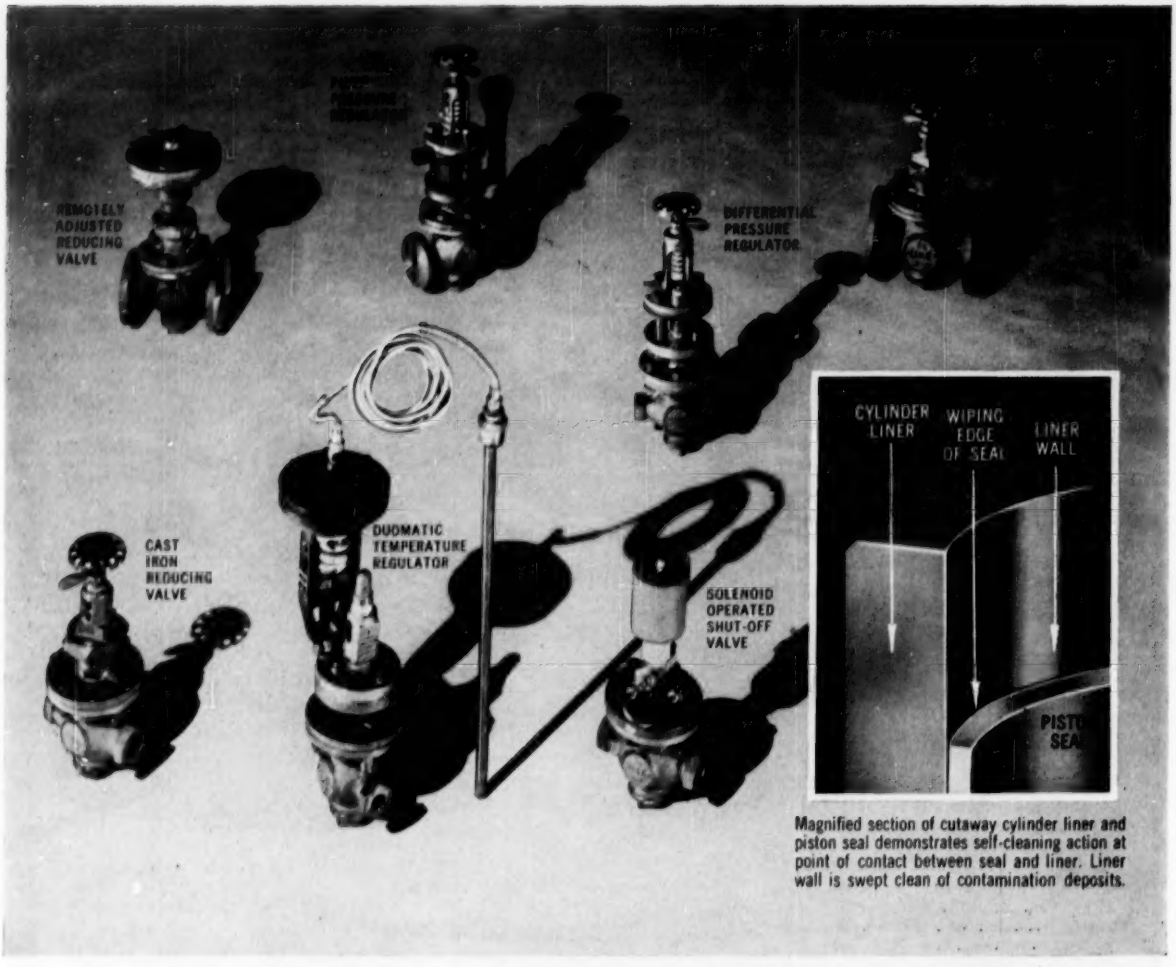
PEERLESS MFG. CO. DALLAS TEXAS

PEERLESS MANUFACTURING CO.

P. O. BOX 13165 DALLAS, TEXAS

Representatives in All Principal Cities

Write for test data showing dust removal and oil loss of Peerless Scrubosphere as against conventional dust scrubber.



Magnified section of cutaway cylinder liner and piston seal demonstrates self-cleaning action at point of contact between seal and liner. Liner wall is swept clean of contamination deposits.

. . . another LESLIE Quality First!

REGULATORS WITH SELF-CLEANING PISTONS

. . . at no extra cost

Now it can be told! After 3 years of exhaustive field tests and over 5,000 installations, Leslie announces the standardization of exclusive self-cleaning, pressure sealing pistons for reducing valves, temperature and pressure regulators in ½ to 6" sizes — another Leslie FIRST!

Continuous Wiping Action

The continuous "wiper" action of the new piston's seal keeps the cylinder liner clean, improves reliability, reduces maintenance.

The molded self-lubricating piston seal has already proved itself in high temperature service up to 500°F.

Reduces Wear and Sticking

The resilient cushion between the piston and cylinder liner reduces wear and eliminates "freezing" or sticking of these parts. The self-lubrication and pressure-sealing of the new piston insures smooth, dependable operation even in the toughest applications and where long standby periods are a problem with ordinary regulators.

Fully Interchangeable in Field

You can have this desirable new Leslie FIRST in *any* piston-operated Leslie regulator now in steam service for all temperatures up to 500°F. A quick conversion kit is available and your present Leslie Regulator can have the new seal added in a matter of minutes.

More Information

More data is available — send for these aids without obligation.

Data Sheet RV-51C — Instructions for converting your present Leslie Regulator to self-cleaning piston type
Bulletin 5302-B — Reducing Valves and Pressure Regulators
Bulletin 5307-A — Temperature Regulators

Or ask to see a demonstration model of the new pressure seal piston.

LESLIE **REGULATORS and CONTROLLERS**

LESLIE CO., 279 Grant Avenue, Lyndhurst, New Jersey

5 ways TOLEDO HI-WEIGH TRUCK SCALES

can help your business grow

TOLEDO
PRINTWEIGH
Weight Recorded By
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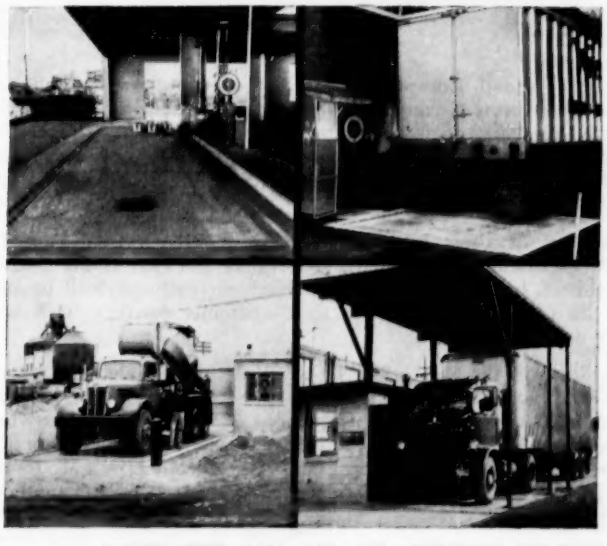
NOW! FULL FIGURE PRINTED WEIGHTS . . .
with New TOLEDO PRINTWEIGH
Features full-figure printing for each 10 pounds from zero to 50 tons. Prints weights on tickets, strips or sheets. Avoids human errors.



There's a Toledo Hi-Weigh Truck Scale for your needs—full range of capacities and platform sizes.

1. *Prevent overweight fines and delays. You know your load* when you weigh on Toledo Hi-Weigh Scales!

2. *Protect equipment and prevent cargo damage enroute.* It's easy to keep loads within vehicle ratings—and achieve correct weight distribution—with Toledo Hi-Weigh Scales.

3. *Prevent weighing errors.* Rugged, reliable Toledo Hi-Weigh Truck Scales are known for precision performance under tough, truck-weighing conditions.

4. *Prevent loss of revenue.* Toledo Hi-Weigh Scales furnish accurate weight data so vehicles can roll with maximum payloads.

5. *Insure that weights are as billed* on outgoing and incoming shipments . . . and so protect customer good-will while providing accurate weight data on materials received.

There's a Toledo Hi-Weigh Truck Scale to suit your needs exactly. Full range of capacities to 60 tons; lengths to 60 feet. Two section, four section and axle load models. All feature advanced Toledo engineering, with integrated lever, weigh-bridge and pit for brute-strength with long-life accuracy. Also Toledo Electronic Scales—no mechanical connections between platform and scale head. Locate dial wherever desired. Ask your Toledo representative for full information, or send for literature.

Request Form #2417.

Toledo Scale Company, Toledo 13, Ohio.

SERVICE
Factory-Trained
200 Cities

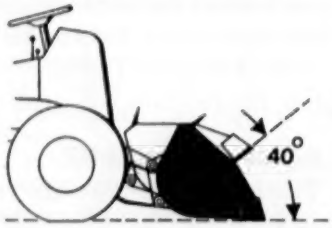
TOLEDO®

Headquarters for Scales

"This PAYLOADER feature* nearly doubled our daily output..."

*40° ROLL-BACK AT GROUND LEVEL

Develops powerful digging force — brings bucket close to machine for maximum stability and carrying capacity, and least spillage loss while transporting loads.



F. W. Tunnell Company, producer of glue, grease and fertilizer, has been operating at the same Philadelphia location for nearly 80 years. It is also a pioneer user of tractor-shovels for bulk materials handling, having bought one of the original "PAYLOADER" tractor-shovels in 1941, and been continuous "PAYLOADER" users ever since.

Speaking of their two new-style model HA units, Tunnell's Vice President, E. N. Angus, says, "This 'PAYLOADER' feature [roll-back bucket] has nearly doubled our daily payload in most of the operation . . . gives us continuous delivery with very low downtime."

Smallest of the "PAYLOADER" line, the Model HA has a 2,000 lb. carrying capacity. Other operating features include hydraulic load-shock-absorbers, torque converter drive, rear-wheel steering, one-lever bucket control, two speeds in either direction. Your nearby Distributor will gladly demonstrate how a Model HA or larger "PAYLOADER" can improve *your* handling methods.

THE FRANK G. HOUGH CO.
754 Sunnyside Ave., Libertyville, Ill.

Send more "PAYLOADER" information on:

- ☐ Model HA (2,000 lb. carry capacity)
- ☐ Larger models (up to 9,000 lb. carry capacity)

NAME_____

TITLE_____

COMPANY_____

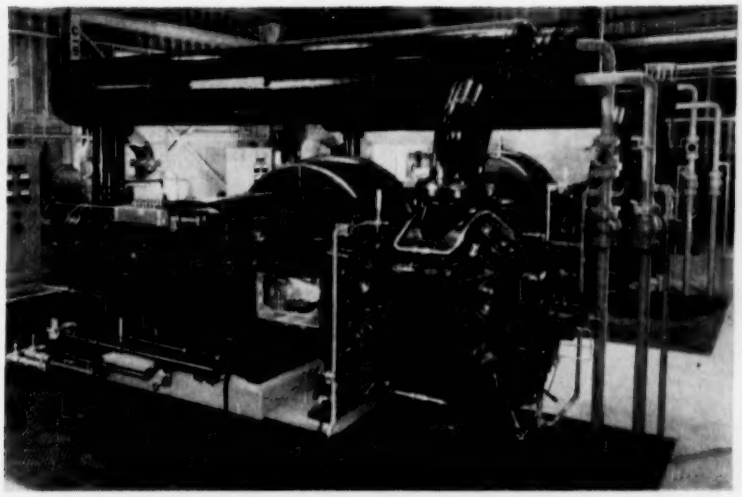
STREET_____

CITY_____ STATE_____

11-A-4

SAY HUFF

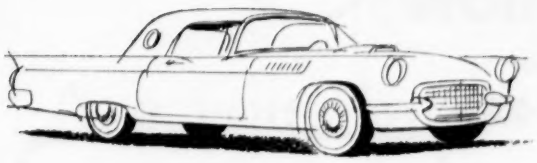
PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY



Cooper-Bessemer JM's *with 5-step automatic unloading in the Rawsonville plant of Ford Motor. Note the windows to observe crosshead action within compressor.*

Cooper-Bessemer industrial air compressors

...helping build the "Ford in Your Future"



Here in the Accessory and Hardware Division, Manufacturing Plant of the Ford Motor Company, Rawsonville, Michigan, two Cooper-Bessemer JM compressors furnish compressed air for general factory and production facilities.

The rugged construction and dependability of these 2-cylinder motor-driven compressors, each rated 600 hp at 300 rpm, assures trouble-free service for many future years. Extreme compactness reduces foundationing and needed floor space, saving installation time and cost. Natural force balance contributes to vibration-free operation and lower maintenance. Find out for yourself how Cooper-Bessemers economically answer every plant air problem.

Motor-driven, turbine-driven, engine-driven . . . Cooper-Bessemer M-Line compressors are available in sizes from 200 to 6,000 horsepower and for pressures to 15,000 and vacuums.

Write for your free *copy of the NEW 44-page Industrial Air Bulletin M-81. Address The Cooper-Bessemer Corporation, Mount Vernon, Ohio.*

Cooper/Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, MOTOR OR TURBINE DRIVEN

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Cooper-Bessemer International Corporation . . . New York • Caracas • Mexico City

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196 595 546 545 496 495

446

VISIT WITH US AT THE CHEMICAL SHOW

Booth 446, *Second Floor* NEW COLISEUM, NEW YORK

Once again, it will be a pleasure to welcome you in our booth at the Chemical Show . . . to talk over your problems on conveying, feeding, and cooling of dry pulverized and granular materials, and your requirements on air compressors and vacuum pumps.

Sales engineers will be in attendance to discuss thoroughly any problems you may have, on which we might be of some assistance to you.

If you are presently handling dry pulverized or granular materials into, through, or out of, your plant, stop in and talk it over with one of our representatives . . . get the full story on harnessing air to move materials. It may well pay you plenty in terms of higher, sustained production at reduced cost.

G-174
4387

EQUIPMENT DESIGNED AND BUILT *by* FULLER

Fuller-Kinyon, Fuller-Fluxo, Airveyor® and F-H Airslide® conveying systems • Fuller Airmerge Blending System • Fuller Rotary Compressors and Vacuum Pumps • Sutorbilt Rotary Positive-Pressure Blowers . . . Gas Pumps . . . Vacuum Pumps • Fuller Preheater—Humboldt Suspension Type • Fuller Inclined-Grate Cooler • Fuller Horizontal-Grate Cooler • Fuller Dry Pulverized-Material Cooler • Fuller Rotary Feeders and Rotary Valves • Material-Level Indicators • Lehigh Induced-Draft Fans • Motion Safety Switch • Aeration Units • Slurry Valves

FULLER COMPANY GENERAL AMERICAN TRADE MARK

Fuller
pioneers in harnessing AIR

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham • Chicago • Kansas City • Los Angeles • San Francisco • Seattle

Are you always "putting out fires?"

Frequent crises in production lines can quickly consume the profits. Picco products are always standing by to fill your processing needs. The wide variety of thermoplastic resins and solvents produced by Pennsylvania Industrial Chemical Corporation are readily available to "put out fires" in your production lines.

PICCOPALE—petroleum polymers
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PICCOLASTIC—low molecular weight styrenes
PLASTICIZERS—aromatic poly olefins
MODIFIED STYRENE COPOLYMERS—substituted styrene copolymers
SOLVENTS—water white aromatics

There is a Picco Sales-Chemist near you—phone, wire, or write the office most convenient for you.

PENNSYLVANIA INDUSTRIAL CHEMICAL CORP.

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Plants:
Clairton, Pa.; West Elizabeth, Pa.; and Chester, Pa.

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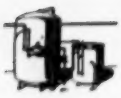
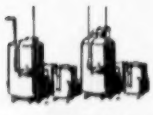
They have placed their trust in ELGIN!

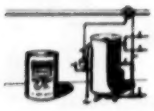


ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

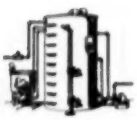
ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.



DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.



CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.

The listing below reads like a roster of the Great Names of American Industry . . . but actually it is simply a partial list of Elgin users!

These are firms and institutions you know well . . . firms that have won the respect of the entire business world for the thoroughness and discrimination with which they choose equipment and services.

All of them have relied upon Elgin products and skill to meet their water conditioning needs . . . often critical and demanding requirements that posed complicated engineering problems. The records plainly show that this confidence in Elgin has been fully justified.

Whatever your water conditioning needs, it will pay you — in immediate results; in long range savings — to place *your* trust in Elgin.

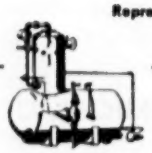
Abbott Laboratories
Aluminum Company of America
American Steel & Wire Co.
American Tobacco Co.
Arkansas Power & Light Co.
Armour & Co.
Bethlehem Steel Co.
Borden Company
California Packing Corp.
Campbell Soup Co.
Carnation Co.
Chemstrand Corp.
City of Denton, Texas
Commercial Solvents Corp.
Dr. Pepper Co.
Drewry's, Limited
Ford Motor Co.
General Electric Co.
General Mills
Howard Johnson Restaurants
Illinois State Hospitals
Iowa Power & Light Co.
Kraft Foods Co.
Kroger Grocery & Baking Co.
Liquid Carbonic Corp.
McDonald Aircraft Corp.
Monsanto Chemical Co.
Morrison Cafeterias
National Dairies
Neisner Brothers Inc.
Phillips Petroleum Co.
Quaker Oats Co.
Sinclair Refining Co.
Sisters of St. Francis Hospitals
Sky Chefs, Inc.
Southwestern Public Service Co.
Stauffer Chemical Co.
Stokely Foods, Inc.
Swift & Co.
Texas Christian University
U. S. Atomic Energy Comm.
U. S. Government (Army, Navy, Air Corps)
University of Iowa
Westinghouse Electric Corp.
F. W. Woolworth Co.

And there are hundreds more ELGIN users almost equally well known!

ELGIN SOFTENER CORPORATION

160 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities — ***In Canada: G. F. Sterne & Sons Ltd., Brantford***



DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

ELGIN WATER CONDITIONING

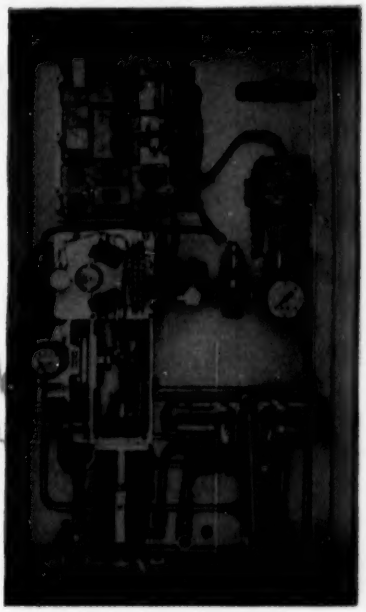
NOW! Cash Standard-Sparton brings you the World's First

Packaged Remote Control System

regulates final control elements governing

- **PRESSURE**
- **FLOW**
- **SURGE**
- **PROPORTIONING**
- **LIQUID LEVEL**
- **SPEED**

and other process variables



SUPERVISORY CONTROL UNIT

For remote location at distances of a few feet to many miles. Operates on telephone, telegraph, private lines or microwave.

Now—for the first time in a single package system—it is possible to control, from a distance of many miles if necessary, the positioning of cone, butterfly, plug and ball valves; sliding stem valves; throttles, rheostats and other variable speed mechanisms; and similar final control elements.

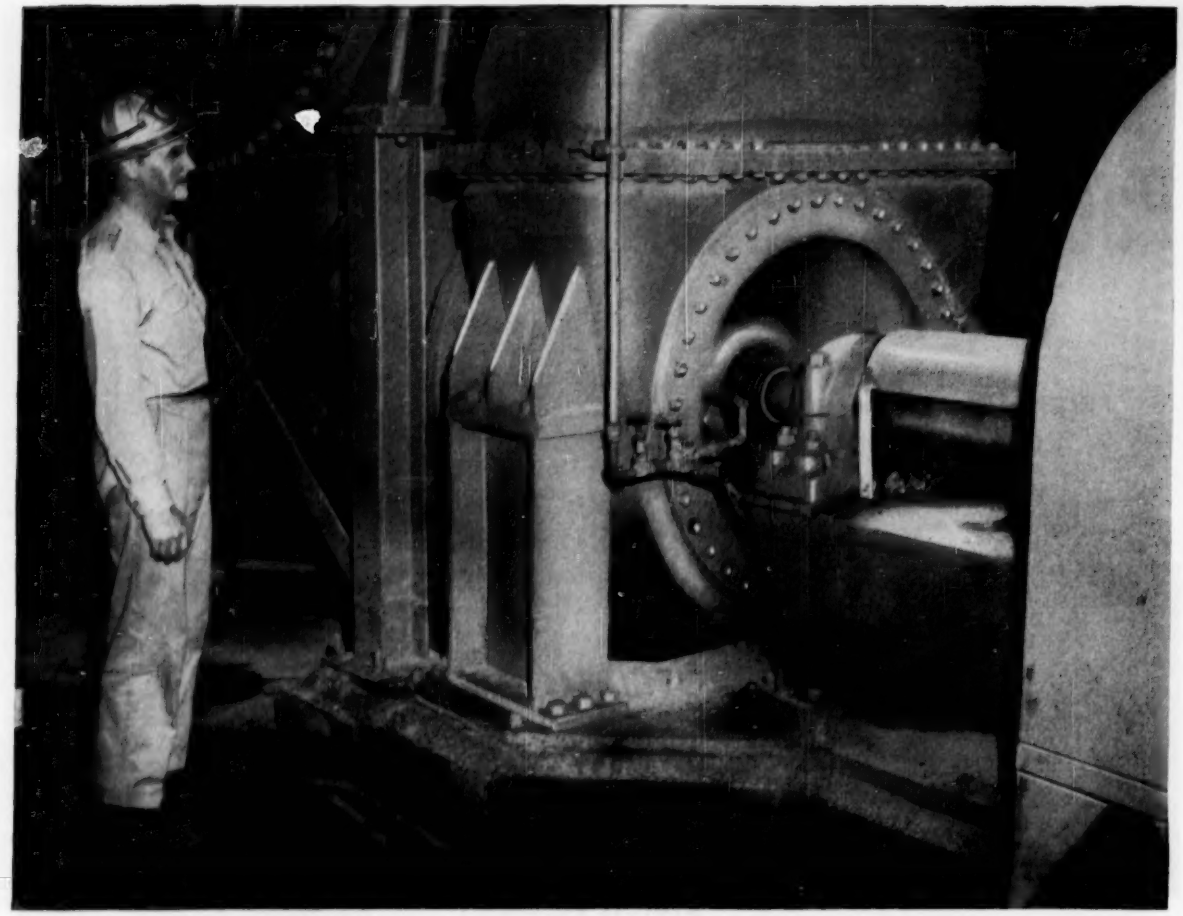
The unique Series 300 Packaged Control System, developed by A. W. Cash Company and Sparton Corporation, reduces operating costs substantially through regulation of final control elements by one operator from one central point. As a result, the equipment pays for itself rapidly. It is recommended particularly for such applications as pipe lines, pumping stations, oil wells, storage tanks, power stations, municipal water distribution, petroleum and chemical processing and atomic energy processing.

For complete information on the remarkable new Cash Standard-Sparton Series 300 Packaged Control System, see the Cash Standard control specialist in your area, or write to Dept. A.

CASH **STANDARD**

A. W. Cash Co. and Its Subsidiary, Cash Standard Stacon Corp.
P. O. Box 551, Decatur, Ill.

Pressure, Hydraulic, Temperature, Process and Combustion Controls



One of the two cast stainless steel (ACI Type CF-7M) screw pumps used to circulate a highly corrosive salt in a large evaporator at Westvaco Chlor-Alkali Division, Food Machinery & Chemical Corporation, South Charleston, West Va. The stainless steel castings lasted twice as long as the best material previously used.

Cast stainless steel doubles the life of pump handling hot corrosive salt

The pump above circulates a solution of calcium and magnesium chlorides with 8-10% solid NaCl in suspension. Specific gravity: 1.4. pH value: 6 at 220°F.

Engineers at Westvaco Chlor-Alkali tried a number of materials for this pump.

Copper and bronze parts failed in 15 months. Cast iron parts lasted 3 years. One type of stainless steel lasted 4 to 5 years.

They finally found what they wanted in Alloy Casting Institute Type CF-7M (19% Cr, 9% Ni, 2.5% Mo, 0.07% max C) stainless steel castings. These nickel-containing castings have been in service *9 years. That's twice the life of the best material previously used. And still no sign of corrosion!*

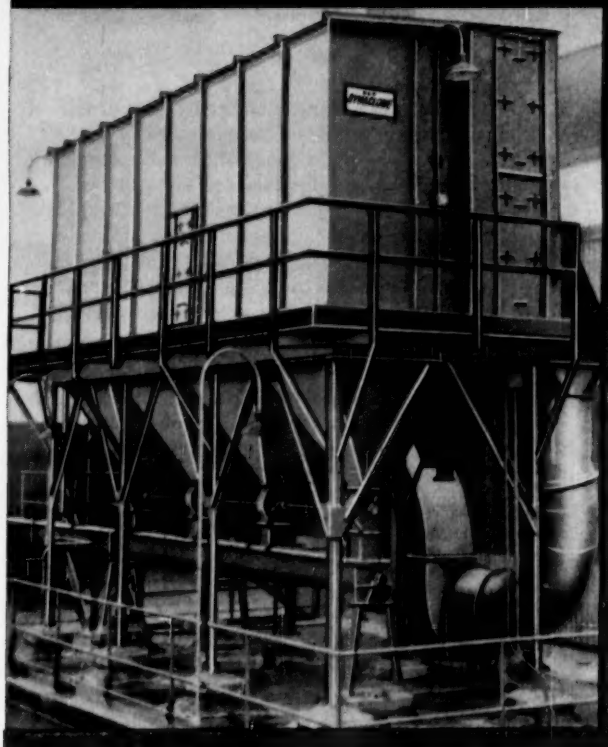
Perhaps a cast (or wrought) stainless steel containing nickel can solve your corrosion problem, or meet some other specific need. For information to help you select the right alloy, get in touch with Inco's Development and Research Division. They'll be glad to help.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL ALLOYS PERFORM BETTER LONGER

Now . . . a New High in Dust Filter Efficiency . . .



SLY "ROLL-CLEAN"

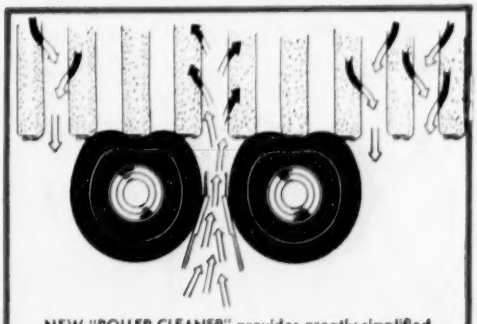
THESE NEW FIELD-PROVEN FEATURES

- Easier filter bag changing.
- Greater cloth area.
- Fewer operating parts.
- Free-rolling cleaner — no sliding.
- Complete dust seal — automatic seal adjustment.
- Easy access to all dust filter parts for inspection and servicing.

PLUS THESE TIME-TESTED DYNACLONE ADVANTAGES

- Constant suction at dust sources — complete dust collection.
- Self-cleaning for continuous operation.
- No auxiliary motors or blowers required for filter-bag cleaning.
- Greater filtering capacity and smaller space requirements — more cloth per cubic foot of filter than any other make.
- Lower power requirements.

The original self-cleaning dust filter, the Dynaclone has proven itself the most efficient dust filter ever made. The "Roll-Clean" Dynaclone combines design simplicity and rugged construction to insure even greater operating efficiency . . . even longer trouble-free service.



NEW "ROLLER CLEANER" provides greatly simplified method of cleaning dust from filter bags. Resilient rubber rolls automatically adjust to form a positive dust seal as each row of bags is cleaned by atmospheric air.

NEW CATALOG

. . . gives full details on "Roll-Clean" Dynaclone and other Sly Dust Filters . . . contains valuable engineering information. Write for your copy.

See it in Space 73, the Chemical Show, New York Coliseum, Dec. 2-6.

SINCE 1870 SLY

THE W. W. SLY MANUFACTURING CO.

4771 TRAIN AVENUE • CLEVELAND 1, OHIO

OFFICES IN PRINCIPAL CITIES

Dracco *Airstream* Conveyors

lead the way in modern bulk handling

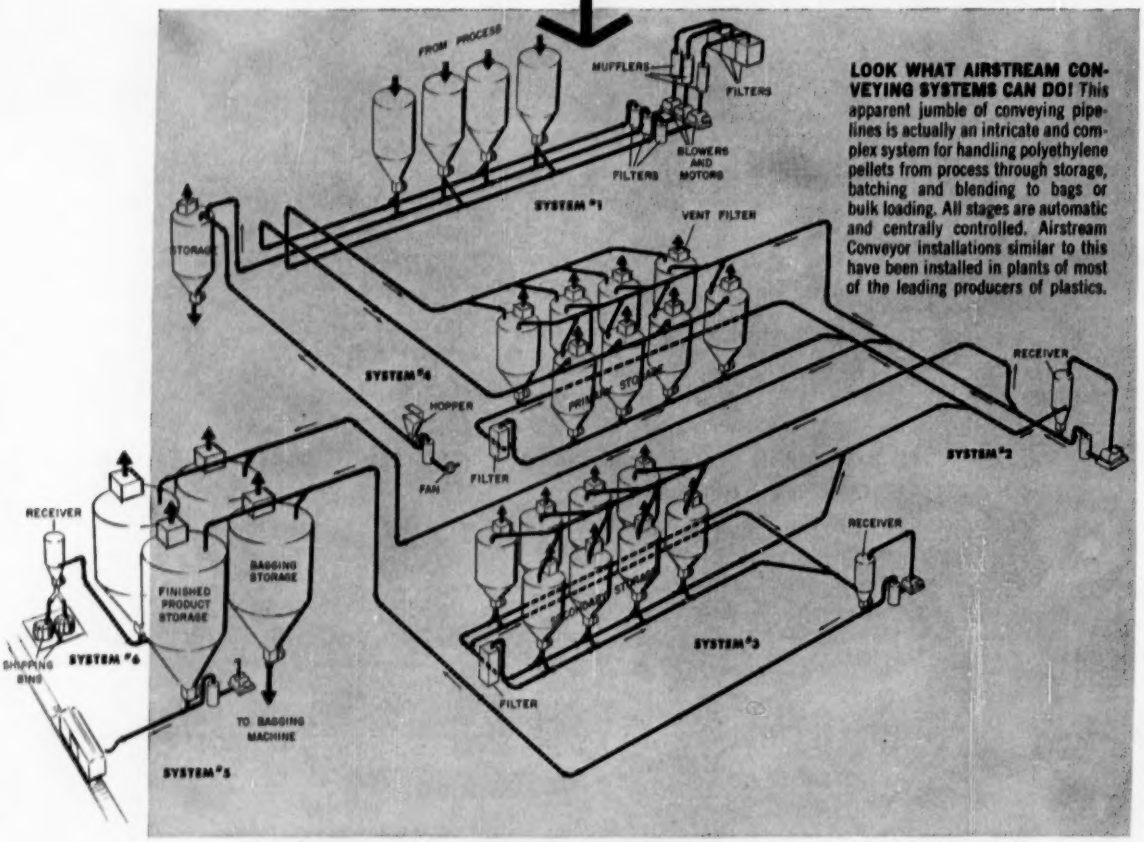
► ***Dracco Airstream Conveyors are the most advanced way to handle bulk materials. They are superior in contamination-free conveying of pure materials . . . gentle handling of friable materials . . . adaptability to automatic control . . . savings in labor, maintenance and material costs . . . installation flexibility . . . cleanliness, inside and out.***

Today's Airstream Conveyors literally bring profits to your fingertips. Push-button controlled by one man, they move bulk materials swiftly and automatically through smooth-walled pipelines to any corner of the plant, or between plants. Diagrammatic arrangement of controls enables the operator to see at a glance all conveying paths in use and material levels in bins. Many operations can be performed: unloading, storing, reclaiming, blending, weighing, distributing and bulk loading.

These are not predictions of things to come, but are actual realities available from Dracco today. Companies planning automation of processes involving bulk materials should investigate handling the Dracco way. New Bulletin No. 530 gives full details. Write for your copy today.

DRACCO CORPORATION

4040 East 116th Street • Cleveland 5, Ohio



LOOK WHAT AIRSTREAM CONVEYING SYSTEMS CAN DO! This apparent jumble of conveying pipelines is actually an intricate and complex system for handling polyethylene pellets from process through storage, batching and blending to bags or bulk loading. All stages are automatic and centrally controlled. Airstream Conveyor installations similar to this have been installed in plants of most of the leading producers of plastics.

DRACCO *airstream* conveyors
dust control equipment

NOW! LOW COST MODULATING CONTROL FOR TEMPERATURES UP TO 600° F

ANOTHER NEW IDEA FROM FULTON SYLPHON

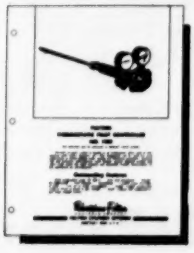
New FULTROL Thermostatic Pilot Controller No. 1100-C & D

Here is another example of how Fulton Sylphon gives you the best temperature control for your process at the lowest possible cost. This time it's an all-new FULTROL Thermostatic Pilot Controller—a simple, compact unit that now enables you to control temperatures up to 600° F. with *proportional* accuracy, but at *on-off* cost.

All that FULTROL needs is an air or other supply at a constant pressure anywhere between 18 and 40 psi. From then on, FULTROL strait-jackets temperature by modulating the output pressure to a final control valve, damper, or other device. FULTROL does all this by means of a simple, stainless steel thermal element. There are absolutely no troublesome pivots or levers.

What's more, you get all these extra features in the bargain:

- Instant knob adjustment of control setting over any 200° range specified between —50° F. and 600° F.
- Easily adjustable proportional band from 5° to 25° F.
- Protection against over-run temperatures (100° above range limit)
- Resistance to pressures up to 300 psi.



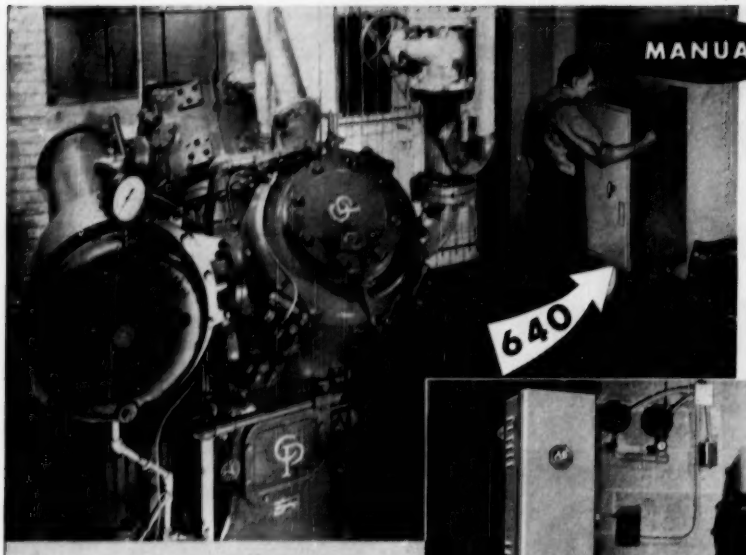
SEND TODAY FOR CATALOG SHEET NO. 10-28-VC

Mr. Controls

Robertshaw-Fulton CONTROLS COMPANY

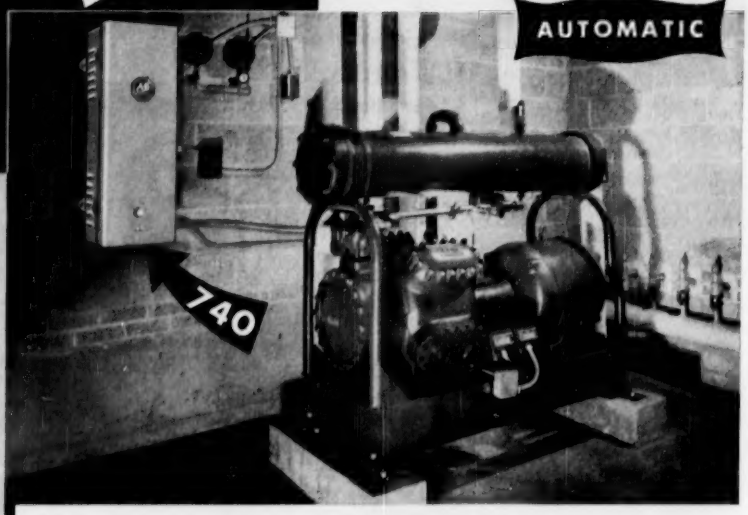
FULTON SYLPHON DIVISION • Knoxville 1, Tenn.

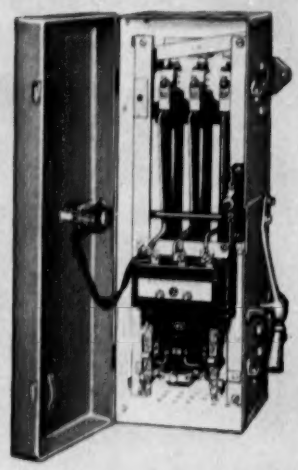
TEMPERATURE REGULATOR HEADQUARTERS, U.S.A.



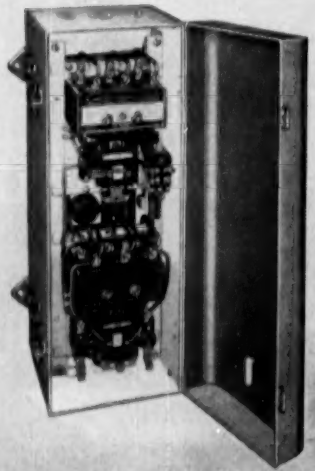
Large CP compressor equipped with Allen-Bradley Bulletin 640 resistance starter. Motor is speeded up by slowly raising starter lever. No current inrush—velvet smooth start.

Trane air-conditioning compressor equipped with Allen-Bradley Bulletin 740 automatic resistance starter. Two-step starter smooths out current inrush—prevents lamp flicker.





BULLETIN 640 manual starter with cabinet open to show the three starting compression resistors.



BULLETIN 740 automatic resistance starter. Starting resistors are located behind the two contactors.

EASY ON THE LINE... EASY ON THE MOTOR

No jerks or jolts—Satisfies the power company

Allen-Bradley compression resistance starters afford a neat solution for smoothing out the starting current and torque of heavily loaded squirrel cage motors. Graphite disc resistors, available only in Allen-Bradley compression starters, control the starting current and torque with velvet smoothness . . . and without lamp flicker.

These jerkless starters prevent damage or undue stress on belts, chain drives, or gears. They are equipped with dependable and accurate overload relays.

Available for squirrel cage motors up to 200 hp, 220-440-550 v. Send for Bulletins 640 and 740, today.

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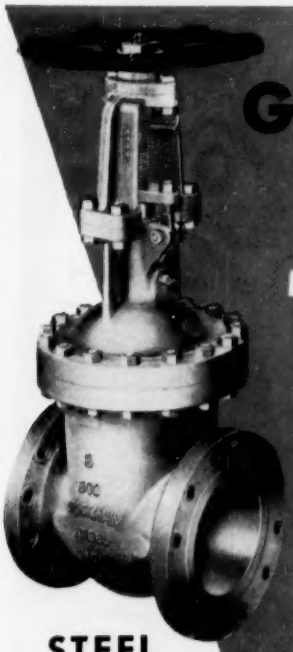

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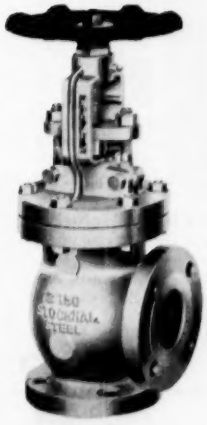

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Look for NETTCO "ENGINEERED AGITATION" in BOOTH No. 79 CHEMICAL SHOW

December 2-6, 1957
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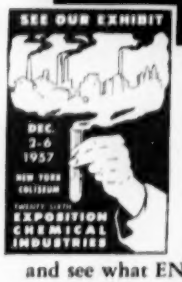

Don't leave the Spinning of your Agitation Wheel to Chance...!

Whether you use a propeller, paddle, or turbine mixer to meet your process demands depends upon how well the fundamentals of agitation are applied to your particular problem. These agitation fundamentals were also basic in developing the most complete, best engineered agitator line available . . . that offered by NETTCO! Stop at our booth at the Chemical Show and see what ENGINEERED AGITATION can mean to you . . . dollar-wise, performance-wise, and NETTCO-wise!

Backed by over 50 years of experience...

- TANK TOP AGITATORS
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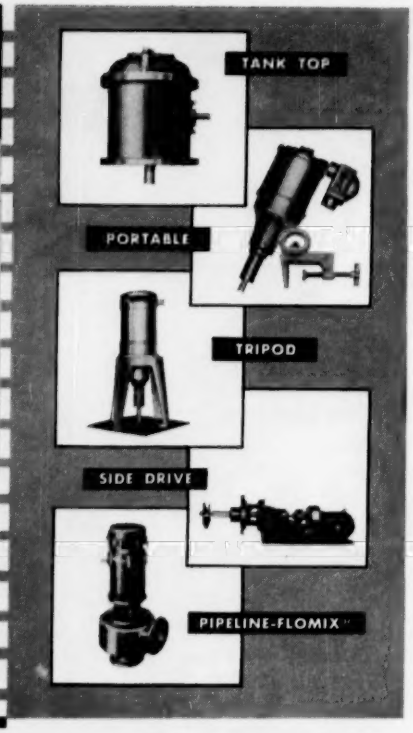
- AGITATOR FITTINGS

If you are unable to attend the show, send your process specifications directly to NETTCO agitation engineers for recommendations. Request free literature on any or all of the agitators listed above. Address requests to New England Tank & Tower Co., 87 Tileston Street, Everett 49, Massachusetts.

NETTCO
ENGINEERED AGITATION SPECIALISTS



ENGINEERED AGITATION

TANK TOP — Model WT (Ratios from 3.5:1 to 68:1); Model T (Ratios from 6.25:1 to 100:1)—Feature clean, efficient designs with minimum moving parts. Variety of motors, shafts, stirrers, and supports furnished to meet specific needs. Bulletin No. 551.

PORTABLE & TRIPOD—For portable, open tank, or closed tank installations . . . in 1/6 to 2 HP sizes . . . with Standard NEMA vertical C flange motors. Feature DRIP-PROOF construction . . . in both high speed and medium speed designs.

SIDE ENTERING—Standard NETTCO units available in ⅓ to 30 HP sizes — offering a variety of speed reduction designs, motor mounts, stuffing box modifications, etc., in alloys to suit process conditions. Bulletin No. 532.

PIPELINE-FLOMIX® — Exclusive NETTCO design for continuous pipeline mixing, increased product uniformity, simplified piping layouts, etc. Suitable for high capacities, pressures, and temperatures. Request Bulletin No. 531 for complete data.

FREE LITERATURE

Please send me the following literature:

- ☐ Tank Top Agitators—Bulletin 551
- ☐ Portable & Tripod Mixers—Spec. Sheets
- ☐ Pipeline-Flomix®—Bulletin 531
- ☐ Side Entering—Bulletin 532

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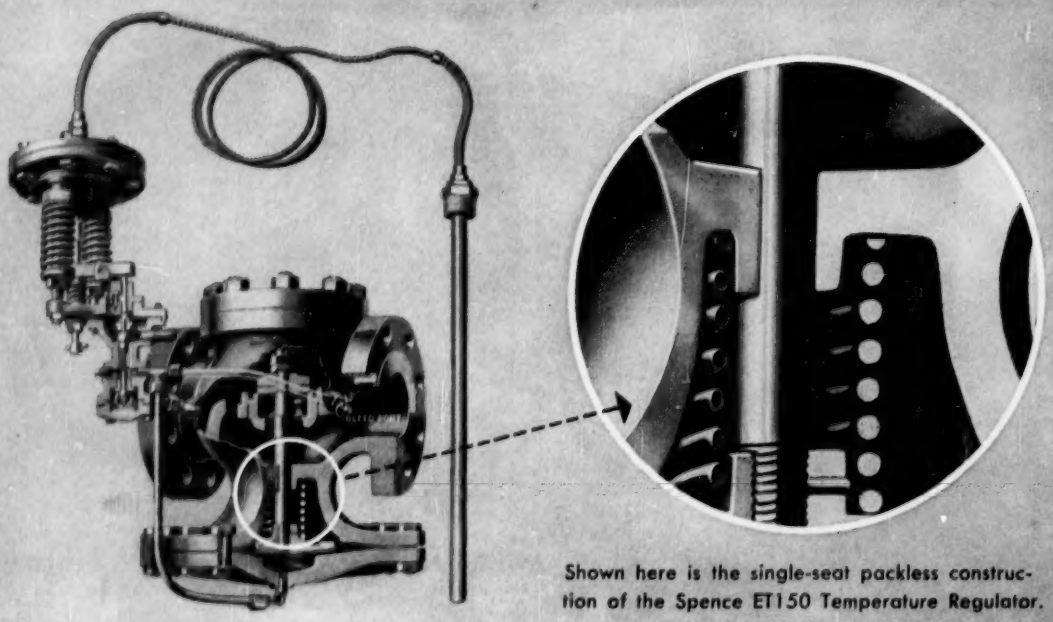
VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, balanced metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

SE 148

There's only one Roll-O-MATIC AIR FILTER

...because there's only one Roll-O-MAT MEDIA!

...and the media is the filter!

A supposedly "equal" air filter might *look* like the AAF Roll-O-Matic, might conceivably even *operate* like it. But the *dirt-stopping* job is done 100% by the *media, and there's no media anywhere in the world like Roll-O-Mat!*

This fluffy white blanket of bonded glass fibers is the result of dozens of AAF research projects involving radically new methods, completely new materials. Roll-O-Mat compresses to paper-like thinness on the roll and loads into the filter like film in a camera. It's pre-charged with AAF viscosine—an exclusive product specially developed to retain its non-sticky consistency under an extremely wide range of temperature and humidity conditions.

There's no equal to the AAF Roll-O-Matic because there's no equal to Roll-O-Mat media . . . and the media *is* the filter! For complete information, contact your local AAF representative or write direct for Bulletin 248A.

AAF — American Air Filter COMPANY, INC.
326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

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FOR THE CHEMICAL INDUSTRY
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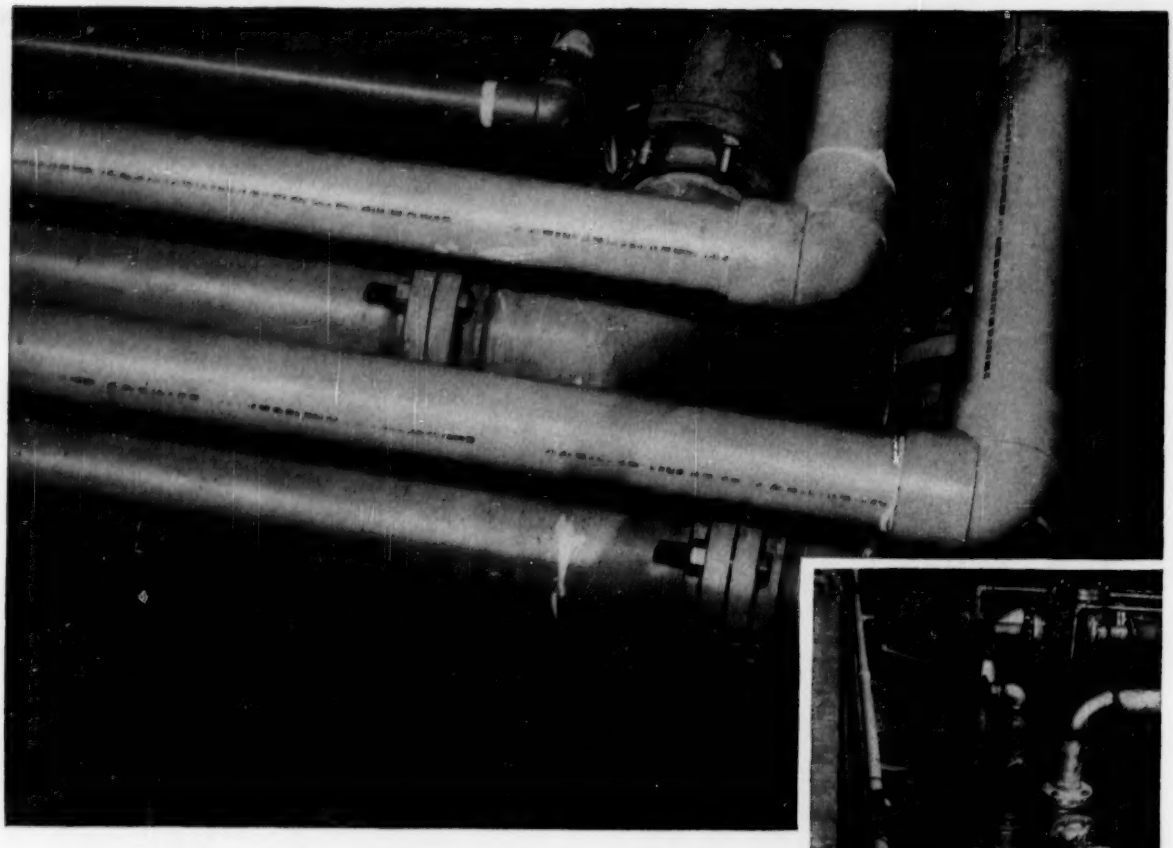
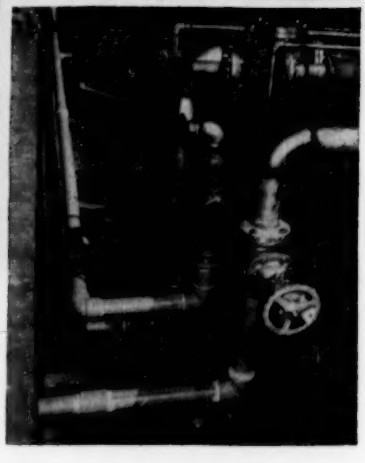




Sulphuric acid and coke oven gas conveyed by National* PVC Pipe

USS NATIONAL Polyvinyl Chloride Pipe is performing two important functions at this steel mill installation:

1. It conveys sulphuric acid from acid storage tanks to pickling tanks.
2. It carries coke oven gas and combustion air from gas booster pumps and air blowers to submerged burners in the pickling tanks.

Polyvinyl Chloride Pipe was chosen for its resistance to internal corrosion from the concentrated sulphuric acid. It conveys acid under gravity flow from elevated storage tanks at ambient temperature, and for its external resistance to 10% to 17% concentrated pickling liquid because the pipes are exposed to acid spillage as steel is lifted from the pickling tanks.

Approximately 650 lineal feet of NATIONAL PVC Pipe were used in this installation. Sizes were 1½", 3", and 6" diameter—schedule 80, normal impact for sulphuric acid, and high impact for coke oven gas and air. The coke oven gas and combustion air is boosted to 6 to 8 psi at temperatures not over 125°.

NATIONAL PVC Pipe comes in two types:

NORMAL IMPACT—for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

HIGH IMPACT—for installations requiring excellent chemical resistance and a high degree of toughness, even at low temperatures.

Available in sizes from ½" to 6" inclusive, and in Schedules A (High-Impact only), 40, 80, and 120.

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Specify Bulletin 24.

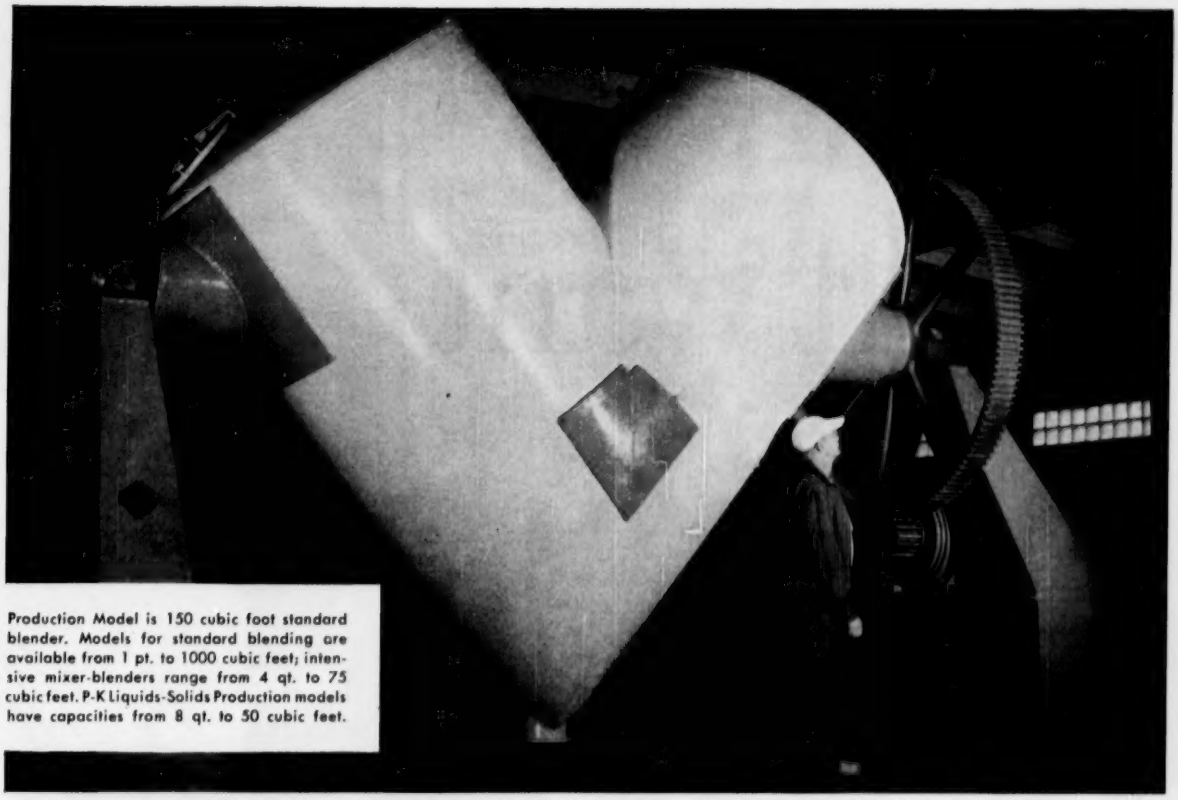
*Trademark

This seal of the National Sanitation Foundation means Tested . . Approved . . Sanitary!

NATIONAL TUBE DIVISION,
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION,
SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL PVC PIPE

UNITED STATES STEEL



Production Model is 150 cubic foot standard blender. Models for standard blending are available from 1 pt. to 1000 cubic feet; intensive mixer-blenders range from 4 qt. to 75 cubic feet. P-K Liquids-Solids Production models have capacities from 8 qt. to 50 cubic feet.

Production Results Prove Superiority of P-K's New Blending Concept

Leading companies in virtually all the chemical and process industries have found that P-K "Twin-Shell" blenders have met their blending requirements better . . . faster . . . and more economically than conventional mixer-blenders.

P-K makes 3 types of "Twin-Shell" models to meet practically all blending functions – there is a production model for standard precision blending, a model for *intensive* mixing-blending, a model where exact quantities of liquids are introduced and intimately blended into dry solids.

These models are all based on P-K's radically different "Twin-Shell" blending concept which has a proven mechanical advantage that pays off in fast, consistently uniform blends . . . dust-free, moisture-proof operation . . . and quick, easy discharging.

The fundamental "Twin-Shell" mixing principle combines a gentle rolling, folding and dividing action within the entire mass of material to create a rapid and uniform blending of formulations regardless of varying particle size, shape or density. Furthermore, the smooth, interior of the "Twin-Shell" blender shape affords complete accessibility for fast, easy cleaning – quick changeover for new formulations without fear of contamination.

Prove these benefits yourself at P-K's Customer Service Lab

P-K can help you to determine accurately the right type of "Twin-Shell" blender for your needs. Complete lab facilities are available for blending materials from 4 qts. to 3 cubic feet (working capacities) – comparison tests can be made on the spot. You and your staff can conduct your own blending studies . . . or you can utilize P-K's qualified blender technicians to assist you in product research. This service is available without obligation because P-K recognizes that more and more companies realize the importance of pre-testing before purchase – they realize too, the need to keep their present blending methods up-to-date. If it is impossible for you to conduct these tests personally, arrangements can be made for you to send us your formulations for testing. In either case, contact Russell Dotter at P-K.

For technical data on P-K "Twin-Shell" blenders for production or laboratory use, write for bulletins 15a-1 (lab) or 15 (production). The Patterson-Kelley Co., Inc., 1511B Hanson Street, East Stroudsburg, Pa. Phone: Stroudsburg 820.

All P-K "Twin-Shell" blenders are patented and the name registered.

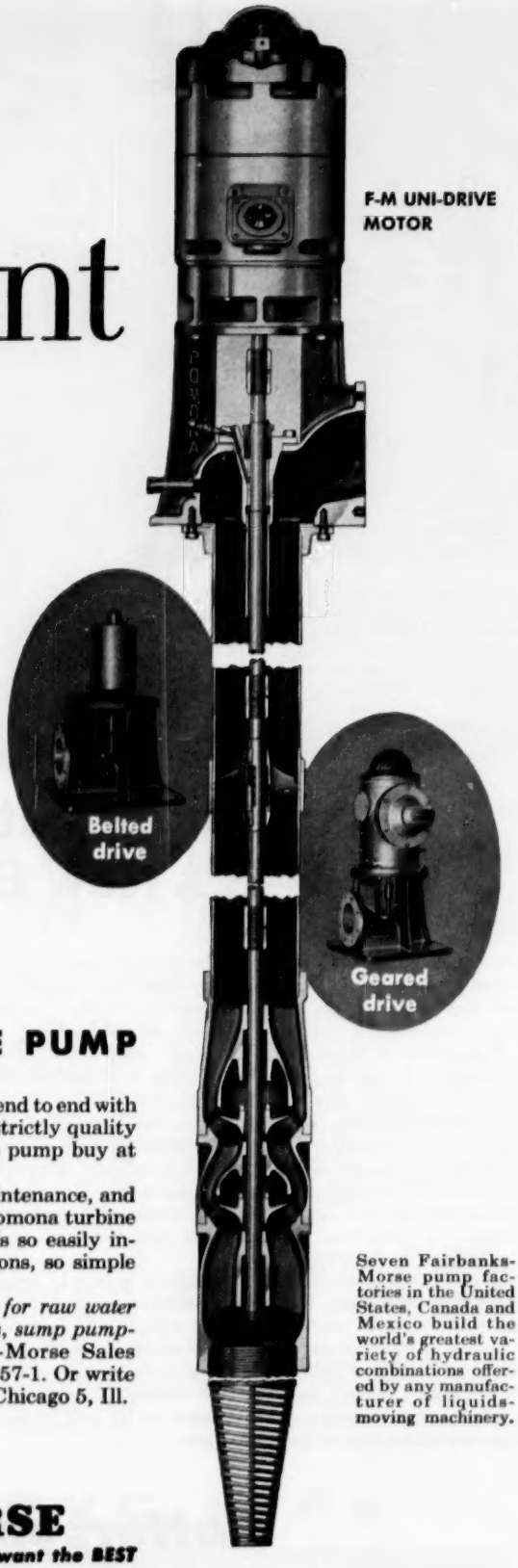
15

Patterson Kelley

Chemical and Process Division

P-K "Twin-Shell" Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors • P-K Vacuum Dryer Blenders

You'll want to look into this pump



NEW F-M POMONA WATER-LUBRICATED TURBINE PUMP

Here is an all-new, extra rugged pump designed from end to end with the cost-conscious user in mind. A close look at its strictly quality features reveals why it's recognized as today's top pump buy at *any* price.

For ruggedness of construction, simplicity of maintenance, and strictly quality design throughout, this new F-M Pomona turbine pump is today's greatest value. No other pump is so easily installed, so easy to adjust for varying field conditions, so simple to change between electric, belted or geared drive.

Ask for details on this new F-M Pomona pump for raw water supply, air conditioning, refrigeration, cooling towers, sump pumping, dewatering, etc. Contact your Fairbanks-Morse Sales Engineer today. Ask for new illustrated Bulletin 6957-1. Or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

Seven Fairbanks-Morse pump factories in the United States, Canada and Mexico build the world's greatest variety of hydraulic combinations offered by any manufacturer of liquids-moving machinery.

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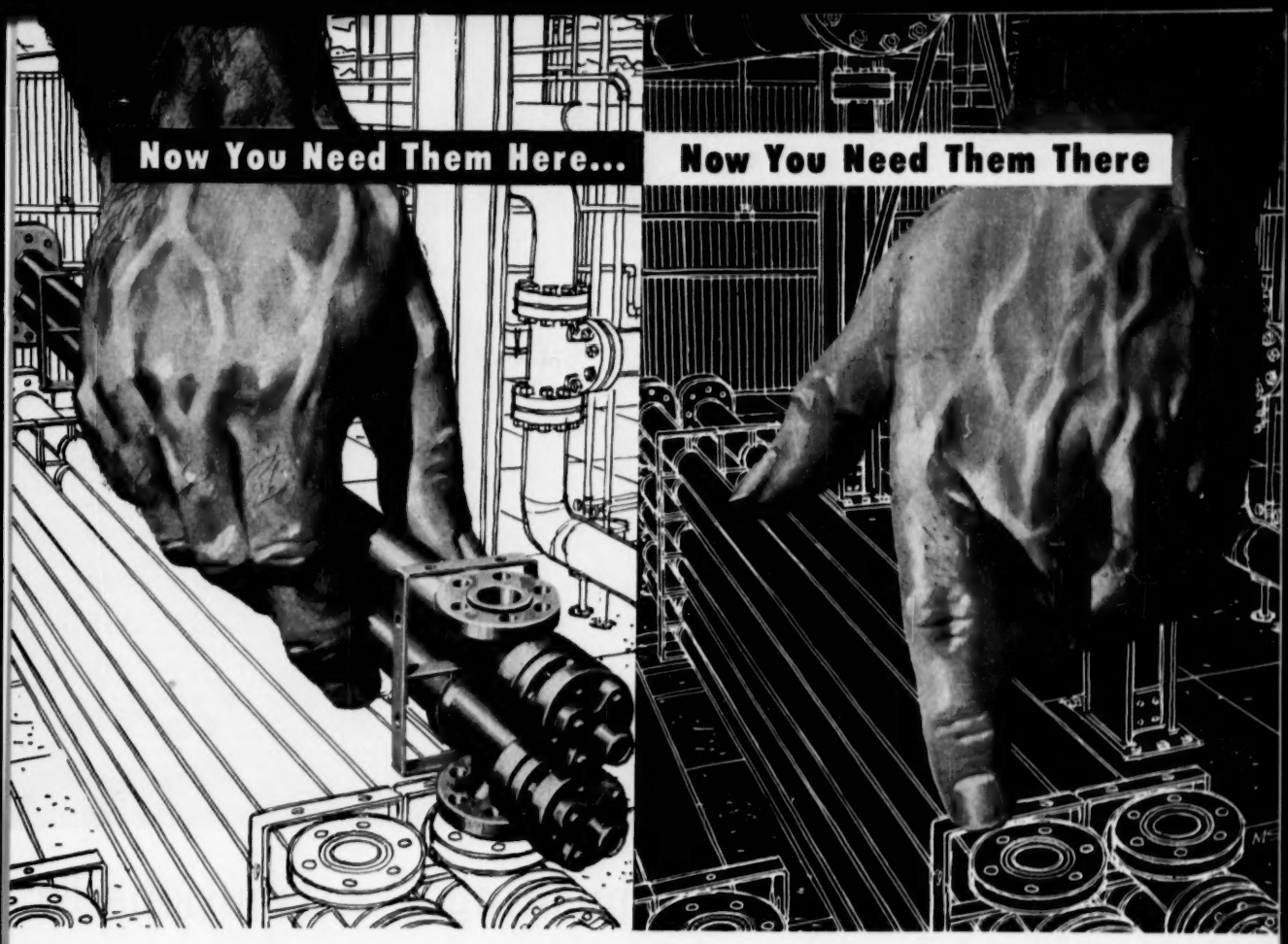


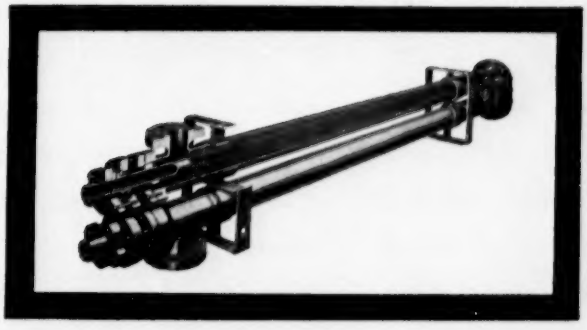
You Can Move ALCOTWIN Heat Exchangers as Loads and Processes Change

The flexibility of ALCOTWIN® heat exchangers means that you can change load or processes within your plant and still use the same heat-exchange equipment. You can easily add new ones for increased load, or you can rearrange present ones for changing conditions. They never become obsolete because of their unlimited number of applications.

ALCOTWINS are in stock in Beaumont, Texas, for immediate delivery when you need them. They are available off the shelf in a number of sizes, for pressures up to 600 psi and temperatures to 650° F.

You get real economy in first cost, in ease of installation and maintenance. In addition, you can select the precise metallurgy needed for best results in your application. The ALCO gas shielded tungsten arc welding method of fusing the fins to the tube permits the widest possible range of metallurgy.

Complete information is available from any of ALCO's sales offices. For a copy of Bulletin FH-3, write Petroleum Industry Equipment Division, Dept. AW-3, P. O. Box 1065, Schenectady, New York.



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Columbia-National Corp.
Zirconium and Hafnium

Honoring Chemical Engineering Contributions to

On Tuesday evening, December 3, 1957, the hustle and bustle so characteristic of Chem Show Week will let up for a few hours, the thousands of lights brightening the more-than-500 booths at New York's massive Coliseum will snap off, and the chemical process industries will pause to salute a monumental chemical engineering achievement.

In the Grand Ballroom of the world-famed Waldorf-Astoria, notables from industry, education and government will gather to pay tribute to the 77 organizations listed above, for their pioneering application of chemical engineering principles and processes to the extractive metallurgy of atomic age metals. Their accomplishments will be recognized by the presentation of the coveted *Award for Chemical Engineering Achievement*, sponsored since 1933 by CHEMICAL ENGINEERING on behalf of the chemical engineering profession.

Recipients of this, the third group award in the history of the honor, were selected by almost unanimous vote of the Award Committee of 90 senior chemical engineering educators under the chairmanship of Dr. Walter G. Whitman of M.I.T.

In little more than a decade, uranium, plutonium, thorium, zirconium and hafnium, tantalum and columbium, lithium, boron, beryllium and the rare earth metals have zoomed from only names in the Periodic Table to, in many cases, tonnage production. Along with three "older" metals—alumi-

14th Biennial Chemical Engineering Achievement Award

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Titanium

Crane Co.
Titanium

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Dow Chemical Co., The
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Titanium and Zirconium

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Titanium

Fansteel Metallurgical Corp.
Tantalum and Columbium

Foote Mineral Co.
Lithium

Freeport Sulphur Co.
Titanium

General Electric Co.
Uranium and Beryllium

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Uranium

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Rare Earths

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Uranium

Hooker Electrochemical Co.
Boron

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Thorium

International Minerals & Chemical Corp.
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Nickel

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Kawecki Chemical Co.
Tantalum and Columbium

Kennametal Inc.
Titanium

Kerr-McGee Oil Industries, Inc.
Uranium

Knowles Associates
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Thorium and Rare Earths

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Uranium

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Titanium

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Titanium

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Titanium

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Uranium

Rust Engineering Co.
Titanium

Sherritt, Gordon Mines, Ltd.
Nickel

Singmaster and Breyer
Uranium and other Nuclear Metals

Stanford Research Institute
Uranium and Thorium

Stauffer Chemical Co.
Titanium and Zirconium

Stearns-Roger Manufacturing Co.
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Titanium Metals Corp. of America
Titanium

Union Carbide Nuclear Co.
Uranium

United States Borax and Chemical Corp.
Boron

U. S. Bureau of Mines
Titanium, Zirconium

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Titanium and Thorium

U. S. Phosphoric Products Div., Tennessee Corporation
Uranium

Uranium Reduction Co.
Titanium

Vanadium Corp. of America
Uranium

Virginia-Carolina Chemical Co.
Uranium

Vitro Corp. of America
Uranium

Wah Chang Corp.
Zirconium, Hafnium, Columbium

Westinghouse Electric Corp.
Uranium and Zirconium

the Extractive Metallurgy of Atomic Age Metals

num, nickel and titanium—they are uniquely the products of *chemical* metallurgy . . . the application of ion exchange, solvent extraction, chemical precipitation and other processing tools of the chemical engineer to the extraction of metals from their ores.

Dr. Zay Jefferies, noted metallurgical engineer and former vice president and general manager of the chemical department of the General Electric Co., will deliver the evening's keynote address: *Chemical Engineering and Extractive Metallurgy—A Fruitful Partnership.* Dr. Whitman will make the presentation. Jesse C. Johnson, director, raw materials division, U. S. Atomic Energy Commission, will accept the 1957 Award in behalf of government and industry.

On the dais, in the audience . . . nearly 2000 engineers and executives from leading chemical and metallurgical companies, research and engineering organizations in industry and government. *You too, are invited.* The form below is for your convenience.

Reception 7 p.m. — Black Tie — Dinner 8 p.m.

CHEMICAL ENGINEERING AWARD
Room 2400
330 West 42nd Street
New York 36, New York

Please make the following reservations for the Chemical Engineering Achievement Award Dinner. My check for $....., payable to CHEMICAL ENGINEERING AWARD, is enclosed. The subscription price of $25 per ticket includes the reception as well as dinner, wines and gratuities.

Mail tickets to:

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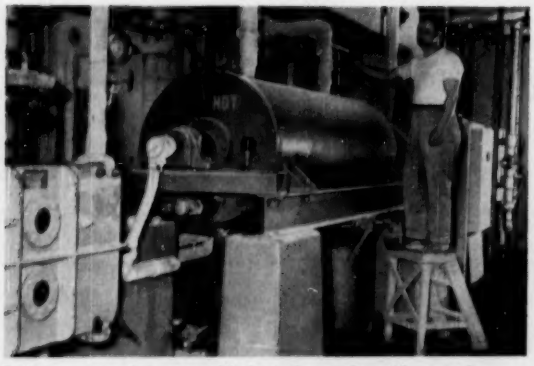
Address .....

City ..... **Zone** ..... **State** .....

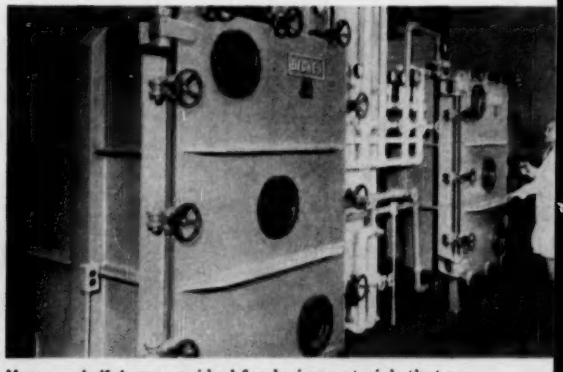
Note: Reservations close Wednesday, November 20, 1957. After this date refunds cannot be made. Please list your name, title, company and city (and those of your guests) on a separate sheet of paper as they should appear in the printed seating list.

Two Stokes Model 214 Double Drum Dryers installed at Penick and Ford, Ltd., Inc., Cedar Rapids, Iowa, for starch production.

other Stokes equipment for chemical processing



Rotary vacuum dryers provide fast, thorough, uniform and economical drying of large batches. Heat is provided through the jacketed shell, and agitation through a double-spiral blade. Vapor can be condensed for solvent recovery. Stokes rotary vacuum dryers are available in a broad range of sizes.



Vacuum shelf dryers are ideal for drying materials that are sensitive to heat and oxidation, and which cannot be agitated. Shelves can be heated by steam, hot water or hot oil. Solvents can be recovered. New Model 238 Line features all-welded steel construction, ASME code certification and full outside manifold connections.

There is a difference ...in Drum Dryers

Your needs dictated the features that are built into Stokes Drum Dryers to give you highest quantity and quality drying performance.

There's more to good drum drying than a heated drum, a drive and a doctor knife. How these elements are designed and utilized can mean the difference between a reliable, profitable process and one that is a headache. The standard "extra" design and construction features of Stokes Drum Dryers give you continuous operation that means no maintenance shutdowns, process uniformity that means more pounds of saleable product, operating efficiency that means greater net profit.

Look at these "extra" features that are "standard" on Stokes equipment.

Steel drums, chromium-plated . . . give high dimensional stability for uniform, maximum production, greater operating safety. Shell rigidity minimizes deflection under reduced pressure operation.

Rigid doctor assembly . . . applies uniform pressure on flexible blade, insuring complete product removal with minimum blade wear.

3-point end-dam adjustment . . . helps eliminate deflection and minimize leakage, keeps power consumption down.

Totally-enclosed end frames . . . guard against gear wear and improve housekeeping.

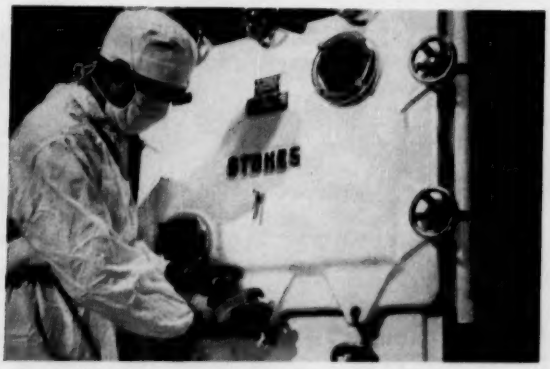
Lateral drum adjustment . . . assures correct edge alignment, minimizes end-dam wear and leakage, prevents costly mis-alignments.

Anti-friction roller bearings . . . mean minimum power consumption, uniform drum alignment.

Compact, variable-speed drive . . . assures maximum power efficiency.

Stokes Drum Dryers are available in both single and double drum types, in a number of standard sizes. Special sizes are supplied to your specifications.

Stokes also produces a broad line of other quality equipment for the chemical and processing industries . . . and maintains a complete laboratory to provide you with expert application assistance. For complete information, write to Stokes or contact your nearest Stokes office.



Vacuum freeze dryers preserve potency in many heat-sensitive pharmaceutical, chemical and food products through drying by sublimation. Dried materials can be stored indefinitely under varying conditions, and are readily reconstituted for immediate use. Sizes for laboratory, pilot plant and production.

Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

SEE HOW SOUTHERN NITROGEN USED ALCOA ALUMINUM TO BAN CORROSION

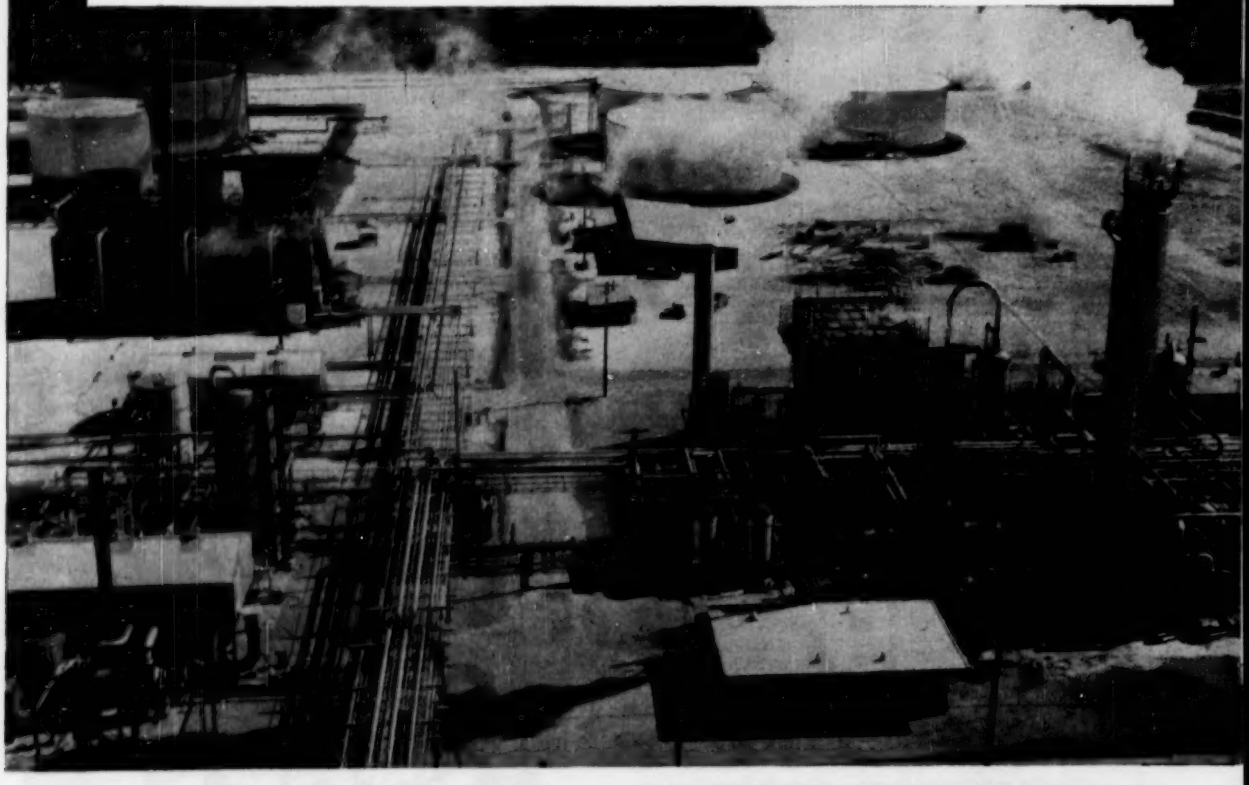
Southern Nitrogen Corporation, the South's newest nitrate fertilizer producer, recently completed a $14-million plant near Savannah, Georgia. Nearly everywhere you look in this modern processing operation you see ALCOA® Aluminum (over 500,000 lbs) at work to combat corrosion. The photographs on these pages show a few of the many ways it is used there.

It's easy to see why Southern Nitrogen used so much ALCOA Aluminum. No other metal provides so many valuable benefits for such a wide variety of uses. And ALCOA, alone, can offer unparalleled technical assistance based on over 30 years' experience applying *all these aluminum advantages in the process industries:*

- *Excellent corrosion resistance* extends service life and reduces maintenance to a minimum.
- *Light weight—high strength* make handling easy and economical . . . often permit substantial construction economies.
- *High thermal conductivity* combined with corrosion resistance often makes aluminum the lowest cost material suitable for many demanding heat transfer operations.
- *Nonsparking!* • *Nonmagnetic!* • *High reflectivity!*
- *Excellent electrical conductivity!*

The plant designers, The Girdler Company, made full use of all the advantages of working with ALCOA. They were able to employ the unequaled aluminum experience of ALCOA engineers . . . to help them choose the right aluminum alloys and fabrication methods for dependable, corrosion-free service in every part of the plant.

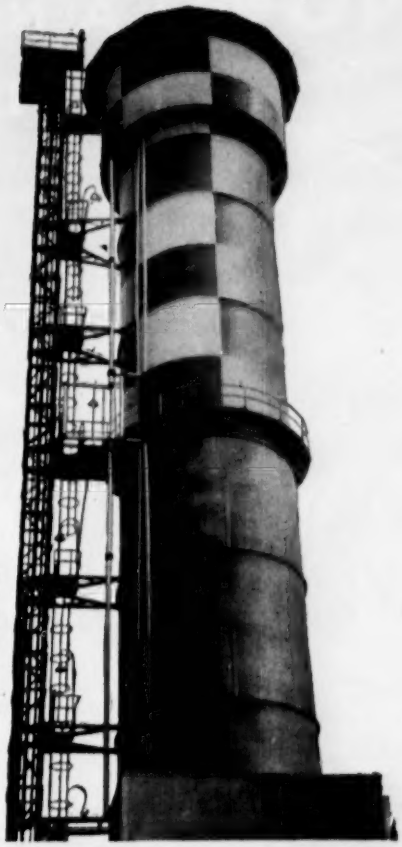
When *you* have a metal problem, call on ALCOA to find a sound, economical aluminum answer. Consult the nearby ALCOA sales office listed in the Yellow Pages of your telephone directory. Or outline your metal needs in a letter to ALUMINUM COMPANY OF AMERICA, 903-L Alcoa Building, Pittsburgh 19, Pa.



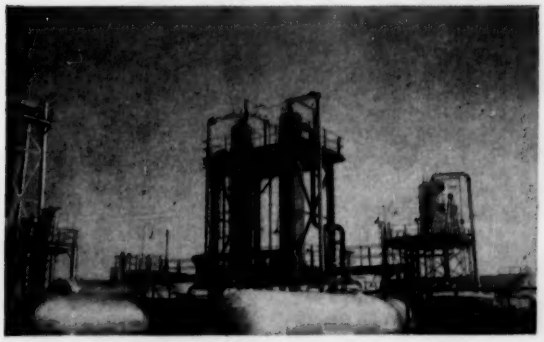
The Girdler Company designed this huge new nitrate fertilizer plant for Southern Nitrogen Corporation. The plant is designed for annual production of 120,450 tons of ammonium nitrate fertilizer, 91,250 tons of nitric acid, 10,950 tons of urea and 328,500 tons of fertilizer solutions.

Plant employs thousands of feet of Alcoa Aluminum piping and conduit and is liberally painted with highly reflective aluminum coatings.

These 1,650,000 gallon storage tanks of Alcoa Aluminum alloy 5052 successfully fight the corrosive action of 85% ammonium nitrate. The tanks, 94 ft in diameter by 32 ft high, were built by Chicago Bridge & Iron Co.

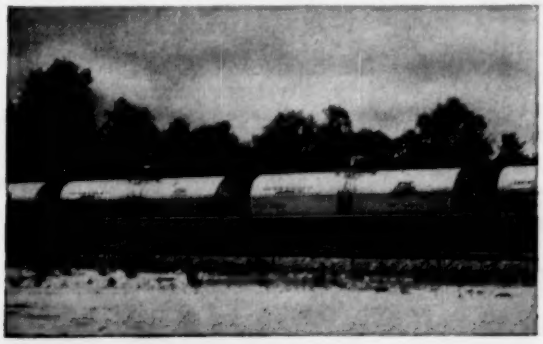


Corrosion-resistant Alcoa Aluminum (alloy 6061-T6) was used throughout this prilling tower . . . to prolong service life without frequent, costly maintenance shutdowns. Built by The Steel Products Co., Inc., Savannah.

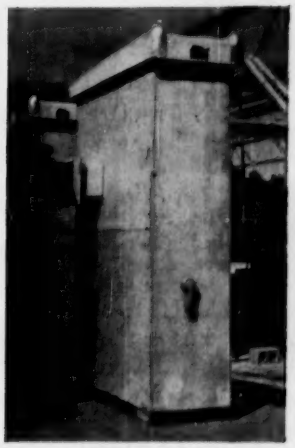


Alcoa Aluminum in these ammonia absorber coolers prevents corrosion while providing constantly high heat transfer efficiency. Coolers built by Henry Vogt Machine Co.

The superior corrosion resistance of Alcoa Aluminum in tank cars prolongs service life and prevents product contamination. Tanks built by Graver Tank & Mfg. Co., Inc. for Union Tank Car Co.



Lightweight gratings of Alcoa Aluminum are used in traffic areas throughout the Southern Nitrogen plant. They stand up under heavy traffic and easily withstand the attack of corrosive industrial atmospheres.

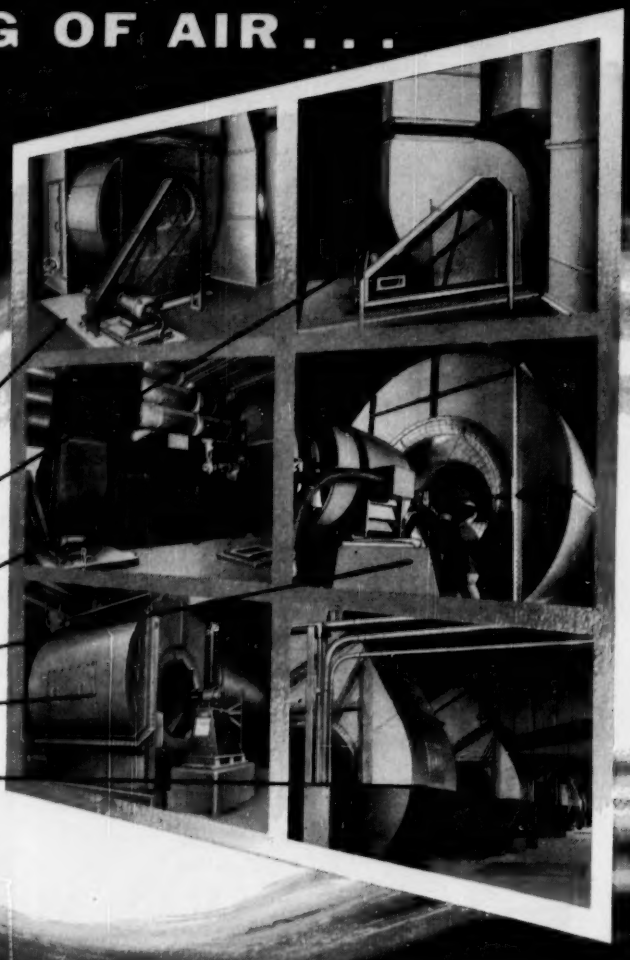


Alcoa Aluminum in electrical bus bar, conduit, fixtures and enclosures gives Southern Nitrogen effective protection from electrical breakdowns during prolonged exposure to corrosive industrial atmospheres.

NEW!
"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

NOW! A NEW STANDARD FOR THE HANDLING OF AIR . . .



FOR

1. Building Ventilation
2. General Supply and Exhaust
3. Conventional and High Pressure Air Conditioning
4. Vehicular Tunnel Ventilation
5. Industrial Processing
6. Combustion Air Supply

Series 8000

NEW AIRFOIL CENTRIFUGAL FANS!

. . . the new standard in a complete line

FULL RANGE APPLICATION

GENERAL PURPOSE

Classes I and II

Up to 6¾" Total Pressure

HEAVY DUTY

Classes III and IV

Up to 16¾" Total Pressure

Up to 700,000 CFM

Westinghouse Airfoil Blading has proved its effectiveness in six years of operation by two hundred customers in Mechanical Draft, Industrial Process, and High Pressure Air Conditioning.

Westinghouse now obsoletes conventional flat blading and brings you the efficiency and quietness of Airfoil Blading for ALL PURPOSE applications in a complete standard line of Centrifugal Fans, covering every requirement up to 700,000 CFM . . . Up to 16¾" total pressure.

J-80640

WESTINGHOUSE AIRFOIL CENTRIFUGAL FANS NOW GIVE YOU . .

- ★ **LOWEST OPERATING COSTS . . .** High Efficiency — Low Horsepower!
- ★ **QUIET OPERATION . . .** Airfoil Blading — Streamlined Air Flow!
- ★ **CAPACITY PROTECTION . . .** Steep Pressure Curve — Minimum Capacity Variation!
- ★ **NON-OVERLOADING POWER FEATURE!** Full Load at Motor Rating—No Overload!
- ★ **AMCA (NAFM) STANDARD SIZES!**

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE . . . IF IT'S Westinghouse

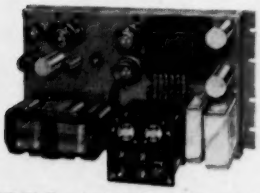
✓ENGINEERS
✓DESIGNERS
✓INSPECTORS
✓TECHNICIANS

For Who Require

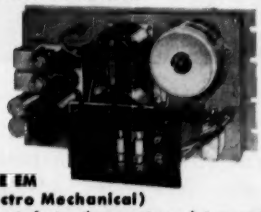
PRECISE VOLTAGE CONTROL

STABILINE®

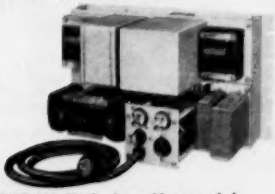
Automatic Voltage Regulators



TYPE IE (Instantaneous Electronic)
Completely electronic with no moving parts. Provides fast, close control. Rated from 0.25 KVA to 10.0 KVA.



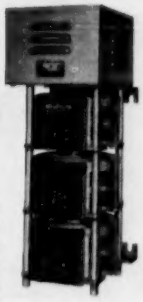
TYPE EM (Electro Mechanical)
Corrects faster than most regulators and operates without waveform distortion. Rated from 2.0 KVA to 100 KVA.



TYPE TM (Tubeless Magnetic)
Without moving parts... tubes... transistors. Ideal for unattended or critical uses. Rated from 1.0 KVA to 5.0 KVA.

POWERSTAT®

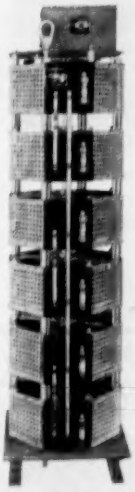
Variable Transformers



MANUAL and MOTOR OPERATED
These variable autotransformers provide excellent regulation with high efficiency and zero waveform distortion. Standard models in ratings from 150 VA to 217 KVA.

HIGH FREQUENCY
units are one-third the weight . . . one-half the size of 60 cycle units. For 400/800 cycle use.

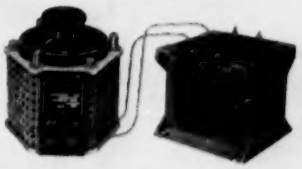
HEAVY DUTY
requirements are met by POWERSTATS in gangs of 6, 8, 9, 12, 16, 18 or more which provide precise adjustments to fractions of a volt.



UNUSUAL CONDITIONS
are met by standard POWERSTAT units that are explosion-proof . . . oil-cooled.

Other Products

in Superior Electric's Complete Line



POWERSTAT Line Correctors correct line voltage variations to maintain a constant output voltage. Can also be used to handle large amounts of current in supplying a limited output voltage range from stable A-C power sources. Rated from 6.0 KVA to 100 KVA.

VARICELL® D-C Power Supplies provide a variable range of stabilized and regulated D-C voltages from an A-C source.

VOLTBOX® A-C Power Supplies consist of a variable transformer, voltmeter and connection leads in one housing.

SUPERIOR 5-WAY Binding Posts — Offered in 5 colors to enhance product appearance and provide circuit identification. Provide 5 methods of connection. Current capacity 30 amperes. Working voltage 1000 volts.

USE THIS COUPON

THE SUPERIOR ELECTRIC COMPANY
1211 Bradley Ave., Bristol, Conn.

Please send following bulletins

- ☐ **STABILINE** — General Bulletin S657
- ☐ **POWERSTAT** — General Bulletin P357G
- ☐ **POWERSTAT** — High Frequency Bulletin P257H
- ☐ **VARICELL** — Bulletin V1051
- ☐ **VOLTBOX** — Bulletin P357G
- ☐ **5-WAY BINDING POSTS** — Bulletin BP656

NAME

COMPANY

STREET

CITY ZONE STATE

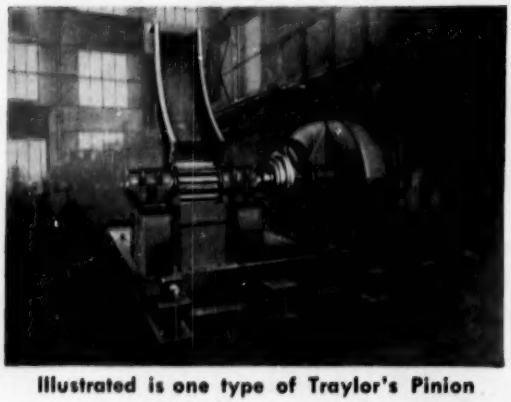
Rely on SUPERIOR ELECTRIC the Complete Line of Voltage Control Equipment

TRAYLOR-MADE

is engineering advancement ✓

9'-6" diameter x 375'-0" Traylor Rotary Kiln in a Portland Cement plant.

Plant installation of 9'-6" diameter x 250'-0" Traylor Rotary Kiln in Portland Cement plant.



Illustrated is one type of Traylor's Pinion Mountings with the gear guard removed.

—Traylor engineering experience in the building of kilns satisfies the demand upon process industries for greater production, and offers many advantages. One Traylor-Made kiln advancement is the "full-floating" type of tire. Special mounting of these tires holds them securely in place but permits them to float free of the shell as it contracts and expands.

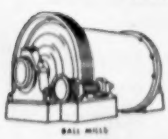
Traylor kiln drives insure production efficiency. The main pinion is of cast, forged or tool steel with low addendum machine-generated teeth. All gears are of heavy proportions to take care of shock load, wear and life expectancy. Write for bulletin No. 1115 today!

TRAYLOR ENGINEERING & MFG. CO., 1950 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco

Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.

Traylor

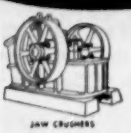


BALL MILLS

ROTARY KILNS

APRON FEEDERS

PRIMARY GYRATORY CRUSHERS



JAW CRUSHERS

SECONDARY GYRATORY CRUSHERS

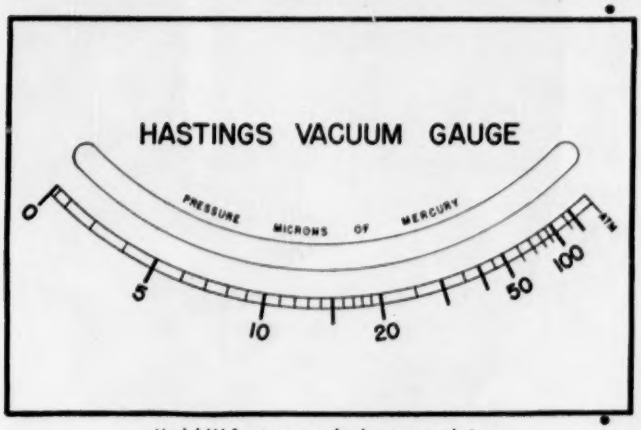
HASTINGS VACUUM GAUGES

FOR

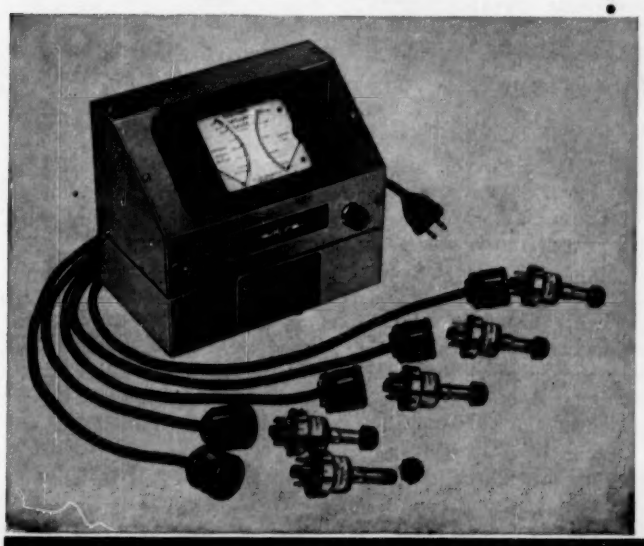
Highest Accuracy

- STABLE PERFORMANCE
- RAPID RESPONSE
- EASY TO USE

Model LV-1



Model LV-1 vacuum scale shown actual size



NEW!

HASTINGS MODEL LV-1 VACUUM GAUGE

Highest accuracy in 0 to 100 micron range. Direct reading without adjustments. Mirror scale with knife edge pointer for accurate reading. Internal voltage regulator takes care of fluctuations in line voltage. Gauge tubes incorporate Hastings patented principle of noble metal compensated thermopiles for greater stability, longer life, more accurate reading. Rapid response in leak detection.

EASY TO READ: Operator can read vacuum directly! EXTRA SENSITIVE in 0-100 micron range!

SIMPLE TO USE: Enables less experienced personnel to take more accurate readings!

HASTINGS MODEL GV-3 VACUUM GAUGE

Measures 0-1000 micron range with high accuracy. Stable calibration. Current set device allows use with any line frequency, or with unmatched gauge tubes. Low in cost but has all advantages of ruggedness, and accuracy. Available with or without five position switching attachment shown.

For the 0.1-20 mm. range, inquire about Hastings absolute pressure indicator.

LABORATORY ACCURACY UNDER INDUSTRIAL PRODUCTION CONDITIONS!

FOR MORE DETAILED INFORMATION WRITE:

HASTINGS - RAYDIST
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HAMPTON, VIRGINIA

AIRCRAFT QUALITY

ALLOY CASTINGS

...for the special requirements of your industry

METALS PROCESSING DIVISION FOUNDRY handles wide range of sizes, closely controls dimensions

Precision testing methods provide close control of casting quality

Curtiss-Wright's Metals Processing Division today offers your industry precision castings of critical parts in a wide variety of sizes, and with closely controlled dimensions. For example, in the large casting shown, tolerance is ±.030 over 36" diameter. From its modern, completely equipped foundry in Buffalo, the Division supplies heat, corrosion and abrasion resistant castings from a full range of special-property alloys, including ductile iron... by sand, centrifugal, ceramic or shell processes.

Precision alloying techniques, modern melting controls with spectrometer testing, X-ray control by experienced radiographers — all add up to castings with superior physical and mechanical properties . . . mean better and more dependable products for the critical needs of industry. Qualified design engineering assistance is a part of the comprehensive Metals Processing Division service. Write for details.

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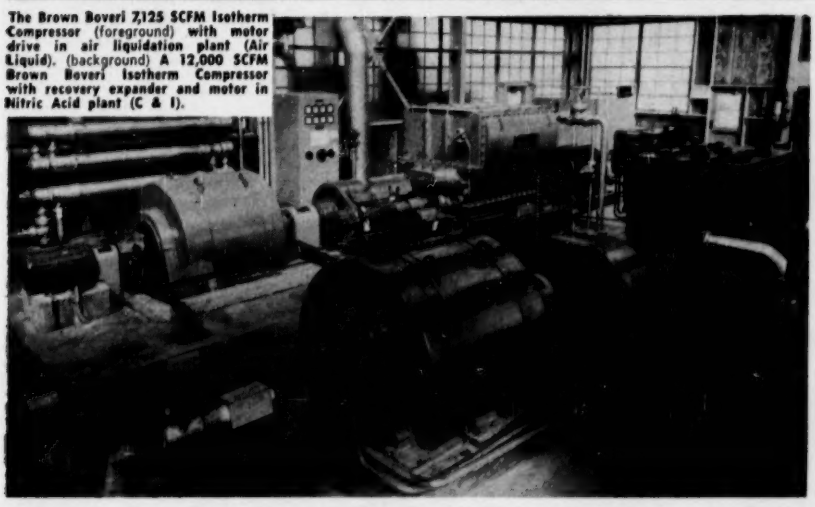
METALS PROCESSING DIVISION
CURTISS-WRIGHT
CORPORATION • BUFFALO, N. Y.

Metals Processing Division Branch Offices: New York • Houston • Los Angeles

for –

Large Volume*
Medium Pressure*

Oil-Free Air
at Lower Cost



The Brown Boveri 7,125 SCFM Isotherm Compressor (foreground) with motor drive in air liquidation plant (Air Liquid). (background) A 12,000 SCFM Brown Boveri Isotherm Compressor with recovery expander and motor in Nitric Acid plant (C & I).

the

BROWN BOVERI ISOTHERM COMPRESSOR

WHERE large volumes of oil-free air (5,000 SCFM and up, 100-300 PSIA)* are required, there is no better equipment available today to achieve "close to isotherm" type of compression, assuring the lowest possible kW input, than a Brown Boveri Isotherm Compressor.

If "tail" gas is available, the high efficiency, reaction type Brown Boveri expander can be applied in the cycle with the Isotherm Compressor to improve further the economy of the process. As drive for the compressor a synchronous, induction or other type of motor, or a steam- or gas-turbine can be used.

Over half a century's background in the manufacture of this Brown Boveri equipment (including control and all accessories) is your positive assurance of the ultimate in the reliability of this "packaged" unit. Write for more information, *today!*

BROWN BOVERI

BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cleveland, O. • Dallas, Tex. • Denver, Colo. • Detroit, Mich. Hamilton, O. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. Pasadena, Cal. • Pittsburgh, Pa. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • San Juan, P. R. • Syracuse, N. Y. • Tucson, Ariz.

POTENTIALS
FOR '58

Point to the demand for essential Plant changes and improvement — Just what will be needed and what will it cost?

As a producer of Chemicals and Chemical Products, you've already considered the factors involved, and you know the end-results you want to achieve, but how can it best be done quickly and efficiently?

The INTERNATIONAL folks at Dayton have the knack of adapting themselves to your problem — of showing you how you can hold down capital investment, thru changes and modification here and there, or by replacement of certain other profit-eating, wasteful equipment.

IF MIXING AND EXTRUSION, Grinding and Pulverizing enter the picture, then INTERNATIONAL ENGINEERING are the logical people to contact for experience and friendly cooperative effort. They are not only qualified to re-design and adapt your present equipment in some cases, bringing it up to date, but they actually manufacture in their own plant, the world's most extensive line of Chemical Processing machinery.

Keeping Step with Progress

Meet Us at the CHEM SHOW
DEC. 2nd to 6th — 3rd FLOOR
SPACE 812

INTERNATIONAL®
Engineering, Inc.
DAYTON, OHIO

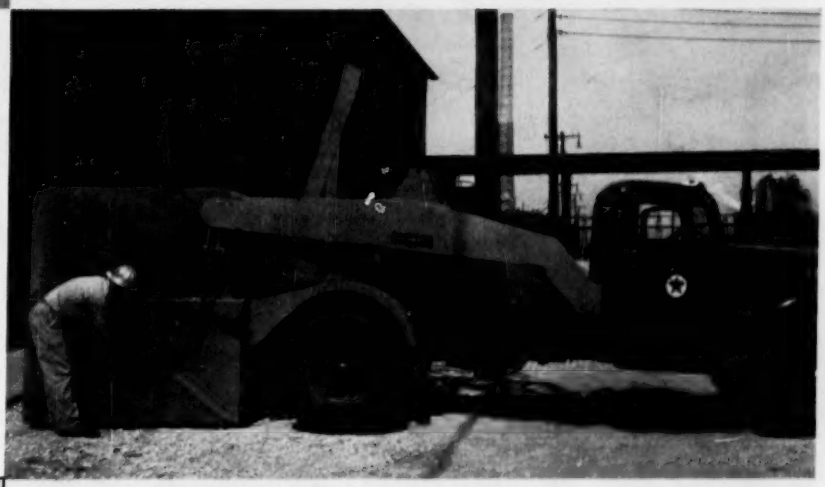
NEW YORK
15 PARK ROW
WORTH 2-2580

TEXACO

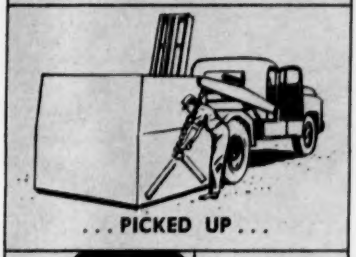
REG. T.M.

The TEXAS COMPANY "CONTAINERIZES" Waste as It Accumulates

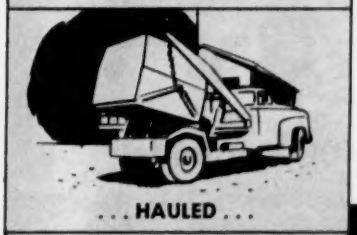
Port Arthur Refinery "Containerizes" Waste, Rubbish and Liquids at Many Accumulation Points . . . Hauls and Dumps Them With Dempster-Dumpsters



WASTE IS CONTAINERIZED . . .



. . . PICKED UP . . .



. . . HAULED . . .

. . . AND DUMPED . . .

Dempster-Dumpster Waste Disposal System Serves Leading Refineries & Chemical Plants

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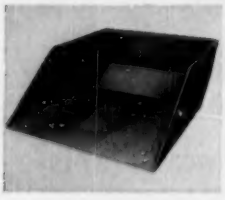
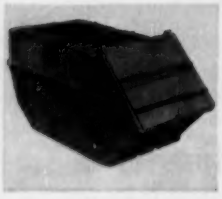
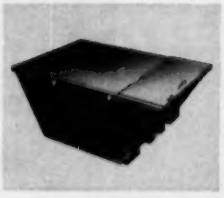


For heavy bulk materials and machinery.

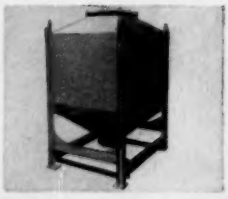


For rubbish and dry refuse.

For all types of fluids.

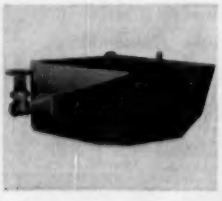


For sludge and liquids.

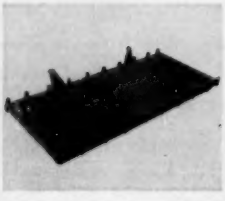


For granular, powdered or heated materials.

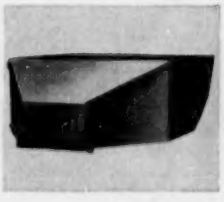
For scrap plate, sheared sections, sludge, castings, similar materials.



For carrying and discharging fluids.



For drums, lumber, pipe, similar materials.



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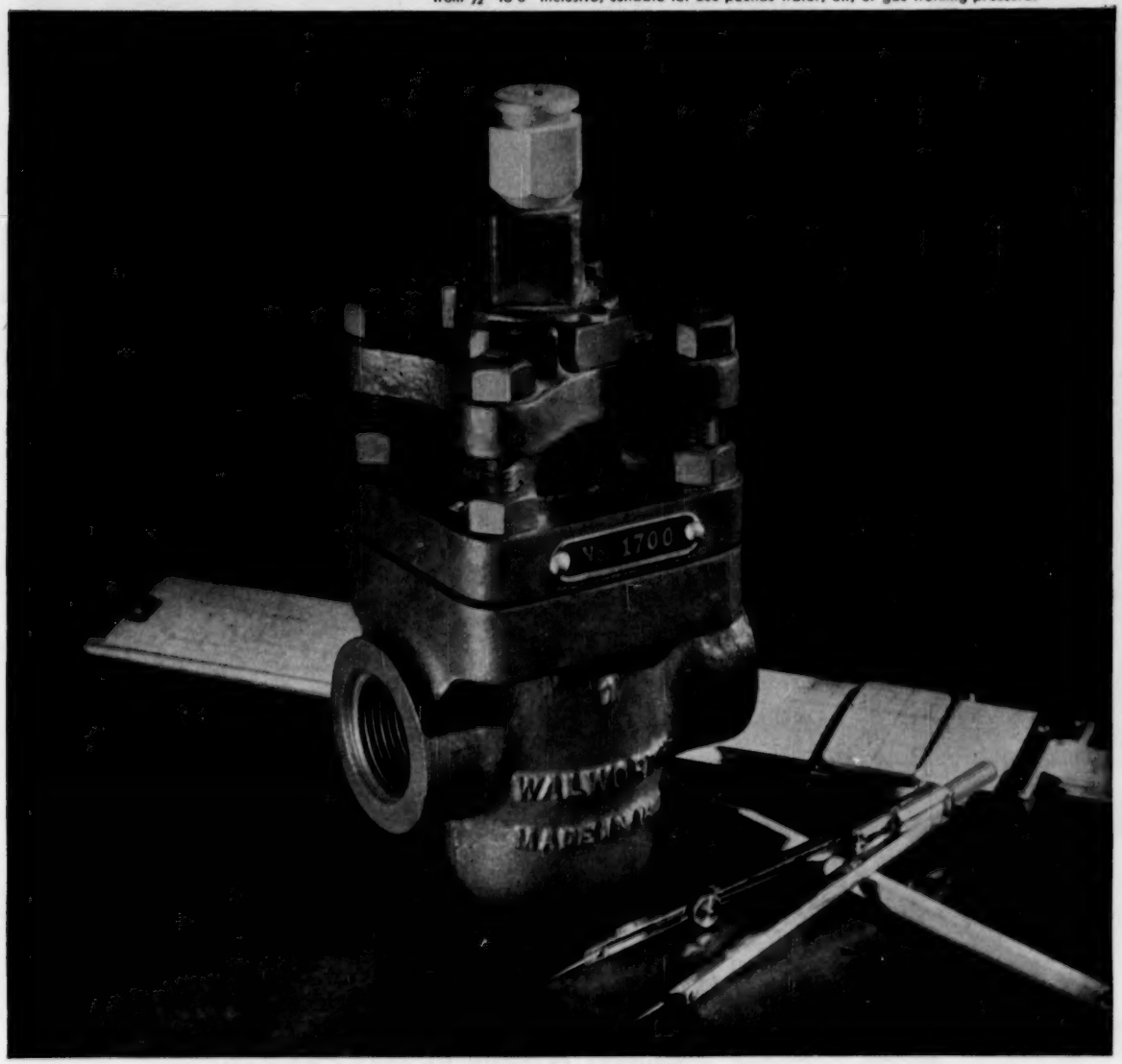

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Important—For pages showing more than one advertised item use this guide to numbers on cards above.

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- 66a Sprinkler systems
- 66b Pipe hangers
- 66c Piping

116 All items discussed
- 116a Pumps, water
- 116b Pumps, high pressure
- 116c Pumps, non-clogging
- 116d Pumps, heat transfer
- 116e Pumps, chemical

151 All items discussed
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- 151b Mixers, portable
- 151c Mixers, side entering
- 151d Mixers, laboratory
- 151e Mixers, Buis. B-109 & B-107
- 151f Seals, mechanical

168-9 All items discussed
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- 168-9b Evaporators, wiped film
- 168-9c Heat exchangers
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- 168-9e Dryer-blenders
- 168-9f Mills, dispersion
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212-3 All items discussed
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- 212-3f 1,2,4,5-Tetrachlorobenzene
- 212-3g Sulfur monochloride
- 212-3h Sulfur dichloride
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- 212-3k Caustic soda, bul. 103
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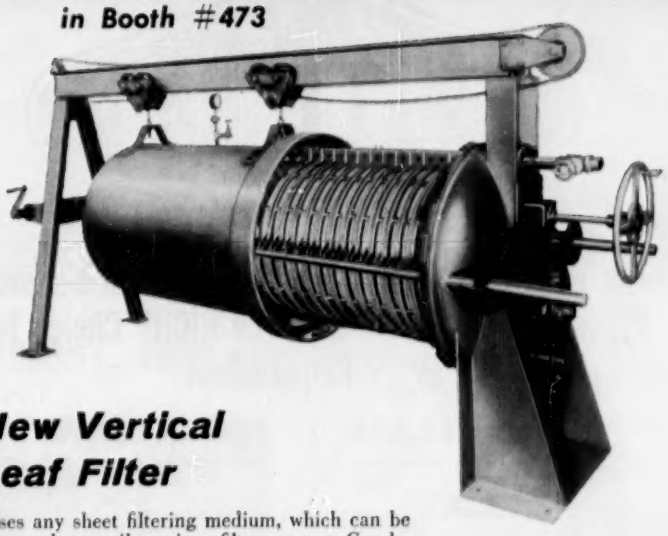
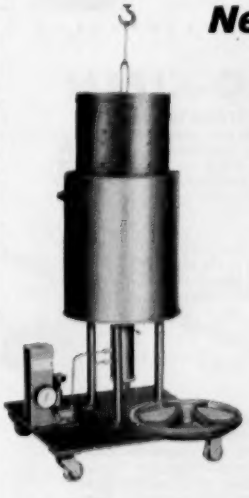


New Vertical Leaf Filter

Uses any sheet filtering medium, which can be changed as easily as in a filter press • Can be used as a precoat filter • Adjustable leaf spacing permits build-up of any desired cake thickness • Filter can be readily cleaned, even if overloaded • No pipe connections to break to clean filter.



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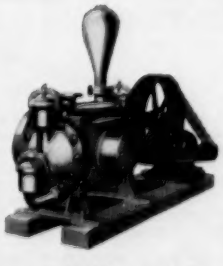
New Diaphragm Pump



New design eliminates danger of injuring mechanical parts in event of diaphragm failure while pump is in operation • Designed for abrasive, corrosive, heavy or other difficult materials, with reduced maintenance cost • No packings, no leakage • No disturbance of piping when replacing diaphragms.

Other products on display—polymerizing reactor and slabber; wax and resin molding press; new all plastic and plastic-coated metal filter press plates, etc.

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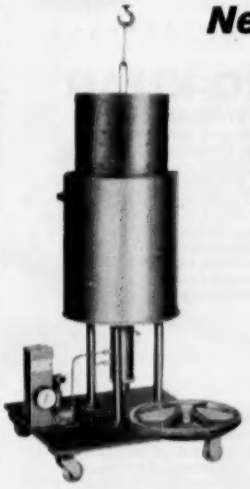

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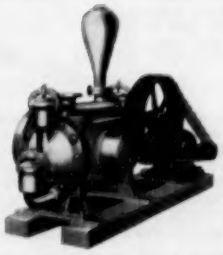

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Continuously cleanable. Combine small size, high flow rates and low pressure drop. A wide range of models and sizes with capacities to 4000 gpm and filtrations as fine as 40 microns.

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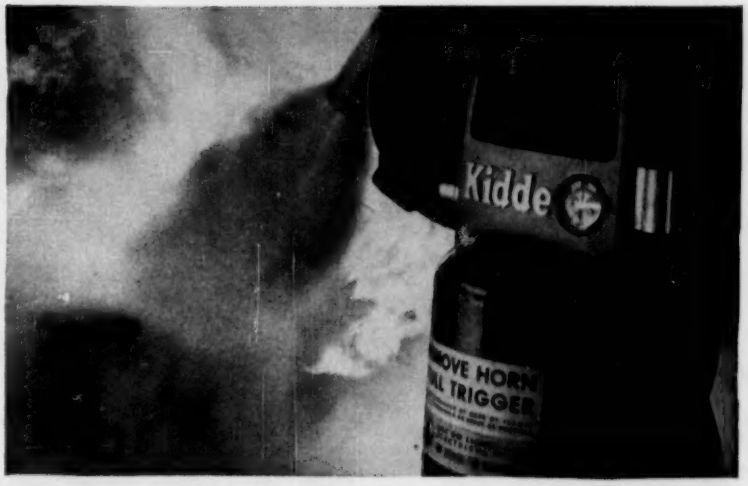

Easiest, fastest way to kill fire...

KIDDE NEW DRY CHEMICAL EXTINGUISHER

Here – from Kidde – is the newest, the fastest, the easiest-to-operate dry chemical fire extinguisher!

Look at the extra large, aluminum handle and trigger – even a gloved hand fits comfortably with room to spare. Pick the unit up – it hangs straight – no awkward angle to throw you off balance.

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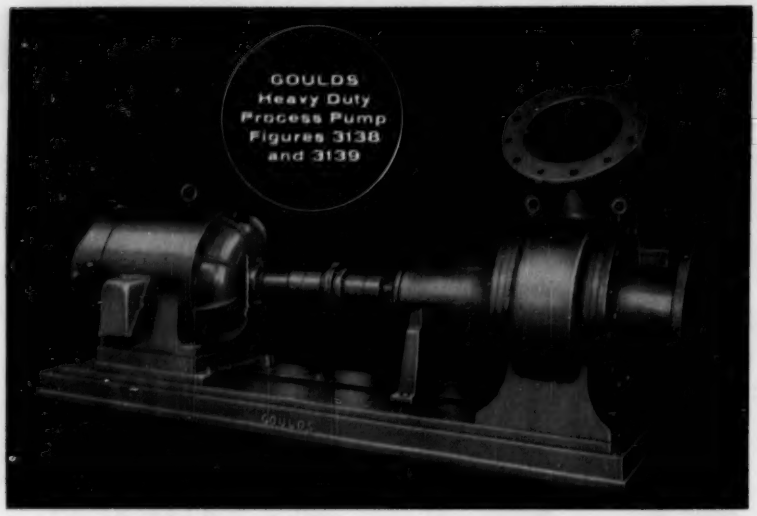


For pumping **heavy slurries** you need a pump like this

These new pumps are specially designed for the toughest service...for pumping corrosive or noncorrosive liquids, with or without solids in suspension. They are designed to stand up under temperatures to 350° F., pressures to 400 lbs.

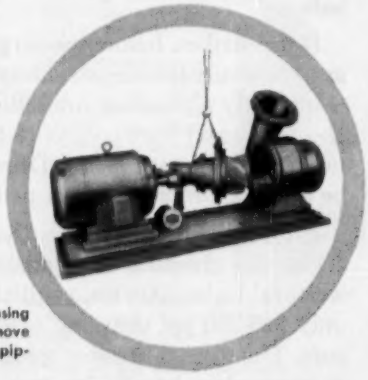
Self-venting discharge ends air-binding, insures steady flow. Ejector vanes keep solids away from the back wall of open, nonclogging impeller. Impeller-to-sideplate clearance externally adjustable. Hook-type shaft sleeve contracts or expands with temperature changes, fully protects shaft.

For pumping corrosives

Goulds Fig. 3138-39 pumps are available with fluid ends in all iron, bronze fitted, all bronze or Type 2 Ni-Resist, nickel-aluminum-bronze, steel and steel alloys (all sand cast machineable alloys).

These special materials of construction are available in all four sizes, with capacities to 9000 GPM, heads to 160 ft.

Full details in Bulletin 723.4.



Easily dismantled. The vertically split casing and "back pull-out" design let you remove the rotating element without disturbing piping, pump case or driver.

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PROTECT
crushers, grinders, screens, all processing machinery, from tramp iron damage
REMOVE
contaminating iron particles from materials and products
PREVENT
fires and explosions caused by sparks from tramp iron

...with DINGS PERMA-PULLEYS

Here is the answer to modern industry's need for powerful, positive protection against tramp iron damage to machines, materials, and products. Dings *permanent* Magnetic Pulleys, made of highest grade Alnico, are designed with extremely high surface strength. They provide tremendous holding power for large, machine-wrecking pieces of tramp iron . . . assure powerful attraction for pulling fine particles of contaminating iron out of material on conveying belts. Separation at full production volume is positive *and automatic*.

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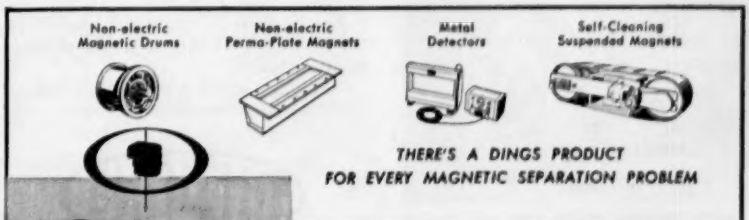
For more detailed information about what Dings Perma-Pulleys can do for you, write for Bulletin C-1007A.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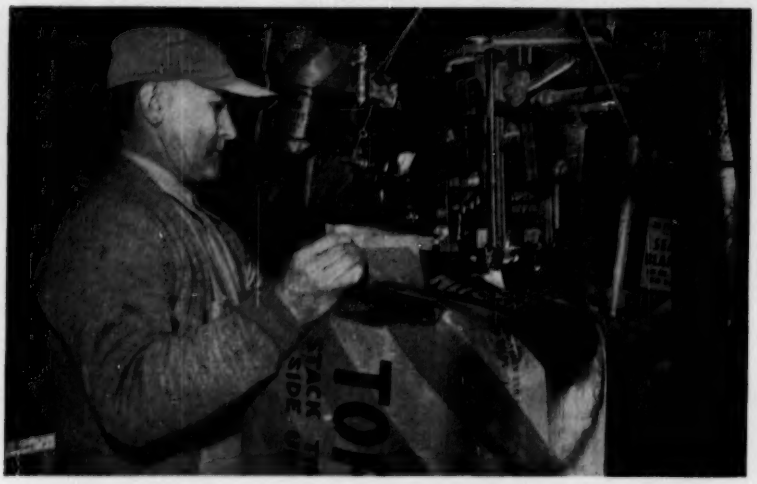
PU-107 8/8



You pay less for this stronger thread for bags

"SUPER CORDURA" SEWING THREAD reduces bag breakage resulting from rugged handling, because seams are much stronger.

"SUPER CORDURA" can be sewn with smaller needles, preventing material losses caused by sifting.

HIGHLY EFFICIENT "SUPER CORDURA" REG. U. S. PAT. OFF. REDUCES BAG AND CLOSING COSTS

GREATER seam strength, increased sewing efficiency, lower cost—these are the advantages of sewing bags with Du Pont "Super Cordura"* high tenacity rayon.

Because "Super Cordura" is far stronger than ordinary-fiber threads, danger of seam breakage is minimized—drop tests prove it. And because sewing with "Super Cordura" is more efficient, you save money in your closing operations. There are less breaks during closing; one thread does most jobs, reducing thread inventory.

Consider the advantages of bags sewn with Du Pont "Super Cordura" the next time you order multiwalls . . . and order it for use in closing, too.

E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Department, Wilmington 98, Delaware.

*"Super Cordura" is Du Pont's registered trademark for its high tenacity rayon yarns.

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Chemicals

Acid, Levulinic.....Levulinic acid reacts as a carboxylic acid, and it functions as a ketone. The 1,4 stereochemical relationship of its functional group often leads to cyclization. Bulletin 301.
86 *Quaker Oats Co.

Acid Thioglycolic.....20 p. catalog entitled "Properties, Reactions, and Uses of Thioglycolic Acid" gives details on applications in pharmaceuticals and food, resins, phenols and amines, gasoline, rubber.
418A Evans Shemetics, Inc.

Acrolein.....“Acrolein and Derivatives,” 38 p., contains a treatise by company's H. Guest on the chemistry of acrolein and methacrolein. Also includes properties and uses of 14 acrolein derivatives available.
418B Union Carbide Chem Co.

Alcohols, Polyvinyl.....23 p. bulletin M13-T on a series of water-soluble resins covers specifications, solutions, compounding, properties, industrial uses. Uses include adhesives compounding, paper sizing.
418C Borden Co.

Amyl Acetate.....Properties, specifications and applications are presented in 8 p. Bulletin F-8911. Includes data related to water extractions and to performance in lacquers.
418D Union Carbide Chem. Co.

Boral.....“Boral for Neutron Shielding,” 4 p., describes composition (boron carbide and aluminum rolled into sheets), uses and shielding properties of new material.
418E Brook & Perkins, Inc.

Carbon.....“Carbon and Graphite for High Temperature Applications,” 8 p., contains application information, key characteristics and tabulated information on grades, sizes and properties.
418F Speer Carbon Co.

* From advertisement this issue

LITERATURE

EDITED BY N. DEGENHARDT

Catalysts.....Harshaw catalysts are available in these forms: tablets, powders, granules, extrustions, spheres and flakes. For hydroforming, cyclization, oxidation, dehydrogenation, etc. Book.
64 *Harshaw Chemical Co.

Caustic Soda.....40-page "Caustic Soda Enginering and Handling Guide" sums up the newest techniques for handling and storage of liquid caustic soda. Diagrams of equipment, safety precautions.
212-3k *Hooker Electrochem. Co.

Chelating Agent.....Bulletin No. 557-1, 2 p., describes a new type of chelating agent, Solo-Onic CH 50, designed to operate in very high pH systems with longer than usual sequestrant life.
419A Sole Chemical Corp.

Chemicals . . . . . Company provides three vinyl monomers, vinyl acetate, vinyl propionate, and methyl isopropenyl ketone for emulsion paints, adhesives, etc. Also data on acrylic acid esters.
203 *Celanese Corp. of Amer.

Corrosion Inhibitor . . . . . Technical data sheet describes triethylammonium phosphate 802 suggested for use in closed systems where water, glycerine, alcohol or glycol are used.
419B Beacon Chem. Ind. Inc.

Elastomers . . . . . Hypalon synthetic rubber is completely resistant to ozone and shows unusual resistance to high temperatures. Neoprene is durable, resilient. Elastomers Notebook & Du Pont Elastomers.
117 *E. I. du Pont de Nemours.

Furfuryl Alcohol.....Furfuryl alcohol is a simple heterocyclic compound consisting of a furan nucleus and a hydroxymethyl group. Useful as a resin former, resin ingredient, etc. Bulletin 205.
334 *Quaker Oats Co.

Gum, Synthetic.....New synthetic gum is said to be an excellent binder that dissolves in water or alcohol to give non-viscous solutions, even in high concentrations. Needs no preservative. TD 1288.
293-4 *U. S. Industrial Chem. Co.

* From advertisement this issue

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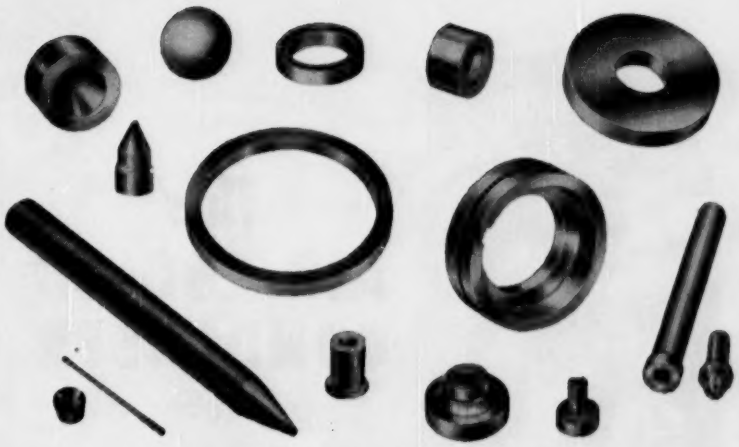

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BETTERS them in Economy and Resistance to Wear!

In the chemical field, and also in the food, paint, petroleum, oil refining, paper and atomic energy industries, equipment components like the ones shown above are often exposed to extremely severe corrosion.

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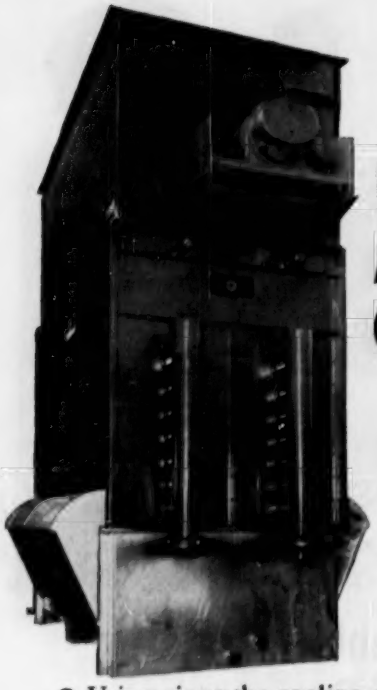
If you have use for valve parts, balls and seats, guides, wear rails, slitting and cutting parts, non-lubricated guides and bushings, metering orifices, sealing rings, in applications where corrosion and wear are problems, ask for full information about Kennametal's K501. Just write: KENNAMETAL INC., Dept. CE, Latrobe, Pennsylvania.

*Trademark of a series of hard carbide alloys of tungsten, tungsten-titanium and tantalum.

C-3067

INDUSTRY AND KENNAMETAL ...Partners in Progress



This AIR-COOLED CONDENSER produces a Higher Vacuum

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It sustains its full capacity in cooling or condensing with no more than a nominal cooling water requirement, eliminating entirely your problems of water supply and disposal.

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For more information write for Bulletin 129R

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Over 35 years of Service in Industrial Air Engineering

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District Engineers in Principal Cities of U. S. and Canada

LITERATURE . . .

Hydrogen Peroxide.....Epoxidation or hydroxylation by means of Solvay hydrogen peroxide offers olefin producers a method of upgrading their products into higher profit items for new markets. Booklet.
175 *Solvay Process Div.

Hydrogen Peroxide.....Up-to-date review and bikliography of the application of hydrogen peroxide for epoxidation and hydroxylation of olefins. Describes potential uses of resulting products.
420A Solvay Process Div.

Inks.....Electronically heat-sealable vinyl gravure inks in a wide range of colors are currently being produced. Prints for automotive upholstery have been heat-sealed without arcing. TD 1283.
293-4e *U. S. Industrial Chem. Co.

Lanolin Derivative.....A new hydrophobic lanoline derivative with good solubility and solubilizing properties is said to be valuable for aerosols, shampoos, suntan preparations, powders. TD 1289.
293-4k *U. S. Industrial Chem. Co.

Latex, Rubber.....“Heat Sensitization of Hycar Latex,” 8 p., discusses the selection of the coagulant and of the protective colloid and procedure and applications. Includes a wealth of tabular data.
420B B. F. Goodrich Chem. Co.

Lithium.....Vol. 1, No. 1, 4 p., of a monthly newsletter, “What's New With Lithium,” reviews new developments in the field. Includes a summary of current articles in trade and business publications.
420C American Lithium Inst.

Mica.....“Wet Ground Mica, Its Uses and Its Properties,” 4 p., has just been revised. Describes wet grinding process in addition to listing properties of the wet ground mica pitment.
420D Wet Ground Mica Assn.

Molding Compounds.....4 p. bulletin P-95 describes new products, a new uses and new markets for users of company's urea, melamine and alkyd molding compounds and nylon molding and extrusion compounds.
420E Barrett Div.

Molecular Sieves.....20 p., triple-punched brochure entitled “Dry Gas? Use Linde Molecular Sieves” provides engineering data for preliminary designs of low dewpoint drying systems.
420F Linde Co.

Olefin Epoxides.....Olefin epoxides show promise as general solvents, solvents and reactive diluents for epoxy resins, intermediates, acid scavengers, corrosion inhibitors. Buls. 72, 73, 74.
37 *Food Machinery & Chem.

Paraffin, Chlorinated.....“Evaluation of Chlorinated Paraffin as a Secondary Plasticizer for Polyvinyl Chloride,” 15 p., covers company's Chlorowax 40 and Chlorowax LV.
420G Diamond Alkali Co.

Petroleum Sulfonates.....12 p. booklet describes the origin and manufacture of petroleum sulfonates. Details behavior, functional properties and applications; data on chemical structure, purity.
420H L. Sonneborn Sons, Inc.

* From advertisement, this issue

Pigment, Red.....A bright new B-O-N type red pigment has a bluish shade, good light and bleed resistance. Said to be lower in cost and easier to grind. Ask about TD 1286 now.
293-4k *U. S. Industrial Chem. Co.

Plasticizers.....6 p. brochure summarizes various investigations into the effectiveness of company's NP-10 in vinyl plastisol formulations. Formulation suggestions are included for various uses.
421A Eastman Chemical Products.

Proteins & Amino Acids.....Proteins and amino acids in animal nutrition are discussed in detail in revised booklet—deals with mutual supplementary action of proteins and other subjects. TD 1282.
295-4d *U. S. Industrial Chem. Co.

Resins....."Resins for the Paper Industry," 5 p., specifically discusses phenolic resins. Covers beater addition procedures, direct and inverted procedures, resin retention, cure and storage.
421B Schenectady Varnish Co.

Resins....."Resins for the Rubber Industry," 30 p., includes general data, compounding techniques, uses with nitrile, GR-S, neoprene and natural rubber, applications chart, product data.
421C Schenectady Varnish Co.

Rust Remover.....Properties and uses of Oakite Drycid, powdered acid scale and rust remover, are described in 2 p. service report B-6564. Recommended solution concentrations and application methods are given.
421D Oakite Products, Inc.

Sequestering Agent.....New additive for caustic bottle washing solutions, an organic sequestering agent called Extend-R, is discussed in a new 4 p. bulletin. Problem-solution format.
421E United Chemical Corp.

Solium Dispersions.....The use of solium dispersions for production of acetylacetone may permit substantial reductions in production costs. 42 page booklet called "Sodium Dispersions".
293-4b *U. S. Industrial Chem. Co.

Solvent.....16 p. booklet outlines properties and uses of inhibited 1,-1,1-trichloroethane, used as a cold-cleaning solvent in adhesive manufacture, aerosols, spray cleaning of electrical equipment.
421F Dow Chemical Co.

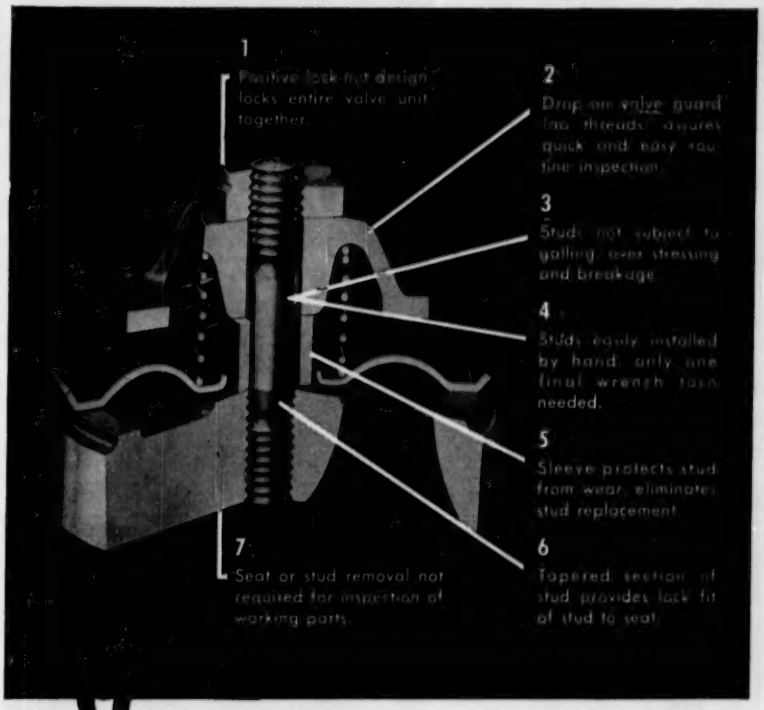
Solvents.....Shell sol 71 and 72 have no odor, are ideal for interior finishes, polishes and cleaners. "Shell solvents for Low Odor and Odorless Paints" contains typical properties on these and others.
147 *Shell Oil Co.

Stabilizer, Anionic.....3 p. leaflet describes SRS-55, company's anionic stabilizer for natural and synthetic lattice. Includes relative stability curves for most commonly used latices.
421G Seaboard Chemicals, Inc.

Surfactant.....3 p. bulletin 957-1 describes uses of a vegetable-oil source liquid surfactant as an emulsifier for edible oil compositions, anti-foamer in sugar cooking systems, wetter-sticker for agriculturals.
421H Sole Chemical Corp.

*From advertisement, this issue

Now...DURABLA Pump Valves offer 7 new points of superiority!


1
Positive lock-nut design locks entire valve unit together.
2
Drop-on valve guard (no threads) assures quick and easy routine inspection.
3
Studs not subject to galling, over-stressing and breakage.
4
Studs easily installed by hand; only one final wrench turn needed.
5
Sleeve protects stud from wear, eliminates stud replacement.
6
Tapered section of stud provides lock fit of stud to seat.
7
Seat or stud removal not required for inspection of working parts.

New V-design assures even greater dependability

You want *maximum valve dependability* for your reciprocating pumps ... and DURABLA gives you just that in the new V-7 unit.

Incorporating seven points of superiority, the new valve features a tapered or V-shaped stud which screws down tight to the seat. This exclusive design anchors the stud, eliminating any possibility of galling, over-stressing or breakage. What's more, the new self-locking nut and drop-on guard assure quick and easy inspection of working parts—without stud or seat removal.

Remember: In the DURABLA Valve, only "point contact" is made by the valve member on the stud sleeve, so it can't bind or hang-up. The open-type guard assures free flow of liquid, prevents clogging.

These stainless-steel valves operate freely under temperature extremes, with corrosives, and in any position. Made in 15 sizes to fit any reciprocating pump, old or new.

Send for *NEW* 8-page booklet CE-117.

Keep your pumps fit with the valves that fit all pumps.

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DM-26

DURABLA MANUFACTURING COMPANY

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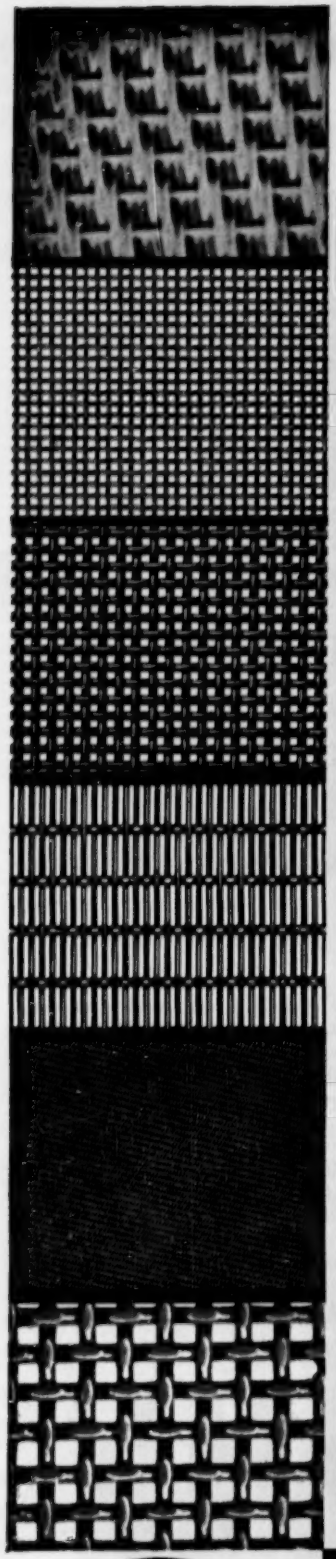

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Specially developed alloys are stronger—longer wearing—resist corrosion and heat—cut replacement costs to a minimum. Accurate openings are maintained! Immediate shipment from stock of most sizes and weaves.

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LITERATURE . . .

Surfactants.....Bulletin 50 gives full details on various emulsifying and detergent applications of an oil soluble alkyl aryl sulfonate. Some users are in dry cleaning "charge soap," emulsion degreasers.
422A Emulsol Chemical Corp.

Urethane....."Urethane — the Next Great Synthetic," 2 p., discusses properties and such present and potential uses as structural material and protective coatings for aircraft, foamed-in-price insulation.
422B United Mineral & Chem. Corp.

Vinyl Resin....."Resin 121 in Plastisol Compounding," 24 p. bulletin PR-4, discusses plastisol flow properties, compounding, computing plastisol formulations, preparation and fusion, applications.
422C B. F. Godrich Chem. Co.

Construction Materials

Adhesive.....A new polyvinyl acetate emulsion adhesive, compatible with dextrine adhesives, is designed for high-speed case and carton sealing. Request information on TD 1281.
100A-Bc
*U. S. Industrial Chem. Co.

Alloys, Corrosion Resistant . . . . . Haynes alloys have excellent resistance to chloride, hot mineral acids, strongly oxidizing salts over a wide range of temperatures. Hastelloy Booklet.
297 *Haynes Stellite Co.

Alloys, High-Strength.....Data sheet ASL 289 M gives detailed information on heat treatment of B&W Croloy 2¼, grades T22 and P22; gives yield and tensile strengths, elongation and Brinell hardness.
422D . . . . Babcock & Wilcox Co.

Asbestos Paper . . . . . How industries save space time and money with J-M asbestos paper is described in bulletin EL-92A. Has charts showing thickness, weight, and tensile and tear strengths of eight types.
422E Johns-Manville.

Coatings, Protective.....Amercoat No. 87, a true vinyl mastic, protects danger spots like rivets, threads, sharp edges, angles, crevices and welds against corrosion. Complete details.
303 *Amercoat Corp.

Coatings, Protective.....Three bulletins available: 33HB—high-build vinyl coating; 35—decorative vinyl weather-resisting coating; 88 — vinyl coating for masonry seals against water vapor.
422F Amercoat Corp.

Corrosion Resistant Materials.....Entire line of Rulon corrosion resistant materials shown in new catalog; mastics for floors, acid-proof bricks, chemically resistant mortars and liners.
422G Ralph V. Rulon Inc.

Fabrication . . . . . Throughout more than fifty years, clients have made use of company's versatile manufacturing experience and facilities to produce unusual fabricated products. Facilities Rklet.
61 *Chicago Steel Tank Co.

* From advertisement, this issue

Fabrication Metal.....Brochure called "Working with Metal . . . at Boardman" gives detailed information about company's metal fabrication ability, as shown in acid tanks erected for Ozark-Mahoning Co.
435 *Boardman Co.

Fabrication, Plate.....Plate fabrication and erection of vessels, tanks, towers, odd and intricately designed chemical equipment, to any size, of any material. Send now for Catalog 54B.
308 *Hammond Iron Works.

Jacketing, Aluminum....."Insulating Jacketing Materials and Methods" gives complete details on dry wall vessel construction, jacketing alloys, aluminum pipe and vessel jackets, fasteners, etc.
40-1 *Kaiser Aluminum & Chem.

Laminates, Metal . . . . . "Bridgeport Metal Laminates", an 8-page book, contains interesting facts on company's metal laminates, including information on bi-metal tube sheets and Duplex tubes.
301 *Bridgeport Brass Co.

Linings, Laminate.....Kel-L laminate is a durable, shatterproof, abrasion resistant, chemically inert fluorocarbon plastic bonded to a glass-cloth backing for good adhesion. Bulletin AD-152.
357 *U. S. Gasket Co.

Linings, Teflon.....Cementable Teflon with one side treated and ready for application to any metal, wood, glass, concrete, plastic or other surface is available in tapes and sheets. Bul. AD-158.
341 *U. S. Gasket Co.

Overlays, Metal.....20-page technical bulletin discusses overlays for abrasion, corrosion, friction, heat and impact protection; charts provide addition data on heat treating. Bulletin TIS 2821.
423A Eutectic Welding Alloys Corp.

Plastics, PVC.....Pipe, sheets, rods and fabricated parts—applications and properties of this versatile plastic set forth in bulletin 80-3. New low cost now offers even greater money-saving possibilities.
423B Joseph T. Ryerson & Son Inc.

Polyvinyl Chloride, Rigid.....Rigid Korseal polyvinyl chloride comes in the form of pipe, pipe fittings, rods or sheet. Very light, readily threaded, drilled, sawed. Can be glued or welded. Bklets.
19 *B. F. Goodrich Ind. Prod.

Polyvinyl Sheets . . . . . Rigid sheets made of geon polyvinyl materials are easily fabricated, light in weight, corrosion resistant. For ducts, fans, hoods and fume stacks Booklet on properties.
9 *B. F. Goodrich Chem. Co.

Refractories.....Data on Refrax high temperature materials is offered in 3 booklets; Refractories Magazine, reprint of Product Engineering article, and Engineering Data Bulletin. On request.
127 *Carborundum Co.

Rubber, Silicone.....4 p. brochure 9-105 describes the electrical insulating advantages of Silastic, company's silicone rubber. Tabular summary of dielectric properties at 25 to 250 C.
423C Dow Corning Corp.

* From advertisement, this issue

then change to a Dow Corning SILICONE DEFOAMER

Why continue to let foam rob you of valuable processing space, inflate your costs, smother your production schedule? Why indeed, when only a teaspoonful of a Dow Corning SILICONE DEFOAMER will prevent mountains of that wasteful foam . . . help you operate at full capacity.

Effective against even the most violent foamers, Dow Corning SILICONE DEFOAMERS are so efficient they pay for themselves many times over. And remember when you use one of these economical silicone defoamers, you also free yourself from the worry of boil-overs and any fire hazards that may result.

So . . . stop choking on your FOAM problems—change to a Dow Corning SILICONE DEFOAMER.

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Put Dow Corning SILICONE DEFOAMERS to the test. Use the coupon below or write on your letterhead to receive a free trial sample. No obligation, of course.

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TITLE

COMPANY

CITY ZONE STATE

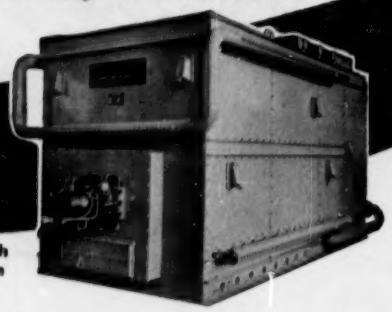
My foamer is

Oil system

Aqueous system

Other

Safe LOW PRESSURE PROCESS HEAT to 750°F. with International-LaMont THERMAL LIQUID HEATERS*



* Especially designed for use with Aroclor, Dowtherm, Mobiltherm and other thermal liquids.

- **FORCED RECIRCULATION** Thermal liquids are kept in constant circulation throughout all tubular circuits of the heater. The possibility of fluid decomposition due to overheating is virtually eliminated.
- **ACCURATE TEMPERATURE CONTROL** to within ±2°F. or closer as required with rapid response to changing load demands.
- **HIGH HEAT TRANSFER RATES** Uniform high velocity circulation, 5′ to 8′ per second, means high heat absorption in all heating surfaces, and permits firing rates beyond the capabilities of other units.
- **LOW COST, LOW PRESSURE OPERATION** ranging from atmospheric to 30 psig . . . with obvious savings over high pressure steam system for comparable temperatures: (1) Operation and supervision costs greatly reduced, (2) No expensive high pressure equipment and controls, (3) Lower installation and maintenance costs.

You'll save money with International-LaMont Thermal Liquid Heaters and Vaporizers—proved best for dependable, economical generation of high temperature process heat for every industrial requirement.

Get the facts—Write for Bulletin TLH.

IBW BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

Steel Firebox Heating & Power Boilers • Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Thermal Liquid Heaters • ASME Code Pressure Vessels & Welded Products

860 Spruce St. East Stroudsburg, Pa.

LITERATURE . . .

Rubber, Silicone.....How properties of company's Silastic can be used to advantage in a wide variety of mechanical parts is detailed in 6 p. brochure No. 9-106. Uses range from jet engines to steam irons.
424A Dow Corning Corp.

Rubber, Urethane.....20 p. booklet outlines in detail the physical properties and characteristics under various conditions of new rubber. Test results are shown in a series of graphs and charts.
424B Gen. Tire & Rubber Co.

Stacks, Fan.....Bulletin describes the application of the P-D out-of-circuit fan stack to the steel and chemical industries. Can eject corrosive, erosive, explosive and hot gases. Bul. 572.
424C *Thermix Corp.

Steels, Clad.....Lukens clad steel is a solid steel plate—one side corrosion resistant metal permanently bonded over-all to a rugged, economical backing steel. "Clad Steel Equipment" offered.
120 *Lukens Steel Co.

Steels, Stainless.....Corrosion resistant steel can be formed into almost any equipment shape or design. Write for "Making the Most of Stainless Steels in the Chemical Process Industries".
115 *Crucible Steel Co. of Amer.

Steels, Stainless.....Catalog presents a technical digest of the most popular stainless steels. Gives description, composition, strength factors, physical properties and applications of a wide range of steels.
424D Sharon Steel Corp.

Tantalum.....A Fansteel publication, Corrosionomics, has articles dealing with the advantages of tantalum, corrosion resistant and possessing high heat transfer characteristics. Available.
R439 *Fansteel Metallurgical Co.

Titanium.....Don't be fooled by raw material costs alone; it's the cost per service year that count. Titanium has a longer service life than other metals. is light in weight. Rem-Cru Review.
112 *Rem-Cru Titanium Co.

Titanium.....Titanium is actually the least expensive metal you can use under many corrosive influences. It understands conditions that reduce the service life of ordinary metals. Titanium Booklet.
200-1 *E. I. du Pont de Nemours.

Electrical & Mechanical

Cable, Electrical.....Type RR cable for power and lighting use is suitable for direct burial, aerial or conduit installation because of tough, flexible plastic outer covering. Data in bulletin RR-10.
424E Triangle Conduit & Cable Co.

Casters & Wheels.....Company supplies casters & wheels with a choice of rubber treads suited to all types of floors, rust-proofing, lubrication with high quality grease, string guards. Manual.
L439 *Darnell Corp.

* From advertisement, this issue

Clamps.....Complete line of Bassick clamps and fasteners shown in new catalog. Features new Gearlock Clamp line which provides air- and moisture-tight seals in heavy containers with closures up to 2000 lbs.
425A Bassick Co.

Couplets.....Forged steel couplets are designed to function as universal outlet connections for tanks, process vessels and pipelines. Available in sizes ¼" through 2". Bulletin CP-1-57.
345 *H. K. Porter Co.

Coupling, Flexible.....New concept in flexible couplings features "rubber tire" design. Accommodates angular and parallel misalignment, end float and torsional vibration. Write for details—bulletin A669.
425B Dodge Mfg. Corp.

Drives, Silent Chain.....Company's silent chain drives survive industry's roughest requirements, are easy to assemble in close quarters and lower in ultimate cost. 88 p. Book 2425.
89 *Link-Belt Co.

Enclosures.....Spin Top enclosures for hazardous locations are available in three ways—complete device enclosure only, or components only, for different types of starters. Bulletin 9990.
163 *Square D Co.

Magnets, Plate.....Bulletin 1071 contains charts and graphs showing how to select right type and size of plate magnet. Magman magnets have exceptionally high tramp iron separating efficiency.
425C Stearns Magnetic Products.

Motor Starters.....Bulletin 640 tells about manual starter with three starting compression resistors. Bulletin 740 describes automatic resistance starter with resistors located behind two contractors.
380 *Allen-Bradley Co.

Motors.....Type EP motors are fully protected against corrosive fumes and liquids, dust, dirt and moisture. Totally enclosed, fan-cooled construction. Data and dimensions in Bul. MU-203.
36 *Wagner Electric Corp.

Motors.....Company has a nation-wide chain of authorized service stations which are never farther away than the nearest telephone if maintenance or repairs are needed. Cat. and Price List CE-11-3540.
173 *Diehl Mfg. Co.

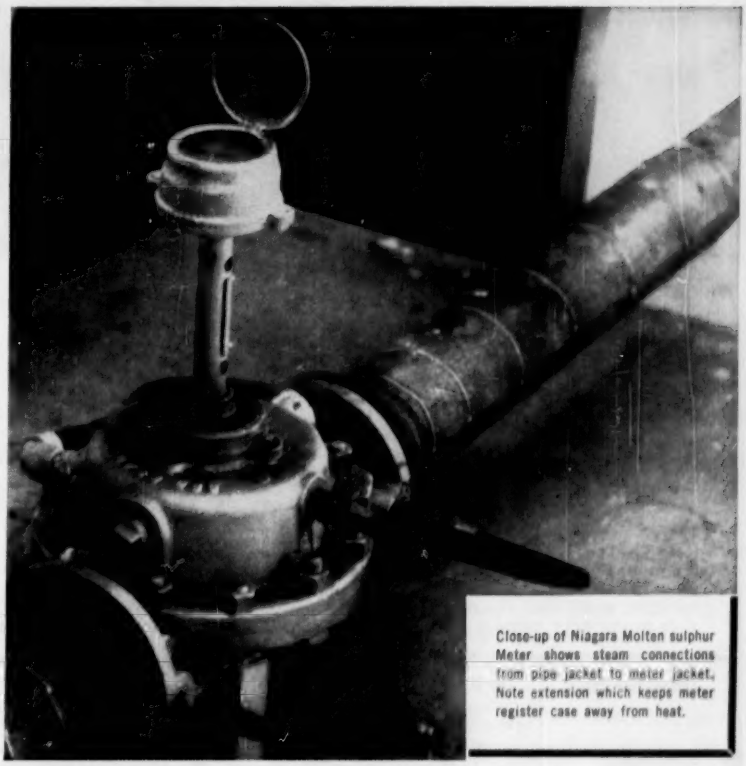
Motors, Corrosion Proof.....Reliance corrosion-proof motors have solid cast-iron housing, including the fan cover, stainless steel name plate, water tight conduit box. Request Bulletin B-2406.
71 *Reliance Elec. & Eng.

Motors, Electric.....New Uniclosed motor now available up to 50 hp.; space savings as high as 46%. 2-way ventilation system for uniform cooling of motor. Bulletin F-1856 brings more information.
425D Elec. Motors.

Motors, Weather-Protected.....Designed for outdoor applications on pumps and other vertical drives, motors are available in ratings of 250 hp. and up. Bulletin 05R8685 shows design features.
425E Allis-Chalmers Mfg. Co.

* From advertisement, this issue

For the difficult Liquid Metering Problems Use Niagara Meters



Close-up of Niagara Molten sulphur Meter shows steam connections from pipe jacket to meter jacket. Note extension which keeps meter register case away from heat.

● Niagara displacement type liquid meters have a surprising range of applications. Their ultra-simple design, and variations of materials enable them to operate under most difficult conditions.

For example:

In the production of sulphuric acid it is desirable to measure the amount of sulphur fed to the burners so that the efficiency of the process can be checked. A Niagara Meter with a steam-jacketed cast iron casing and stainless steel working parts was selected for the job.

Since April of 1955 more than two million gallons of lime neutralized and filtered, dark Louisiana sulphur have been metered at a rate of 560 G.P.H. . . . without a shutdown for repairs or maintenance.

There is a dependable Niagara Meter to meter almost every liquid including caustic soda, sulphuric acid, soap, petroleum products, fruit juices, calcium chloride, alum and many others. The Niagara water meter line is standard for cold or hot water measurement.

Please send me information on Niagara Chemical Meters.

Liquid.....

Flow g.p.m.....Temp.....

Name.....

Company.....

Address.....

BUFFALO METER CO.
2891 Main Street
BUFFALO 14, NEW YORK

REMOTE BULB, INDICATING TEMPERATURE CONTROL

E32N

Featuring Control Point Accuracy Equivalent to Individually Calibrated Instruments

The **UNITED ELECTRIC** Type E32N Temperature Control is a uniquely designed instrument that is used to control and indicate temperatures of gases, liquids or hot plates over wide ranges. This unit contains a 12-inch scale for easily read visual indications. It is possible to replace the thermal unit in the field without any loss of calibration accuracy.

Temperature Ranges	– 150°F. to 150°F., 70°F. to 370°F., 100°F. to 650°F. Read temperature on continuous, 12-inch indicating scale that rotates against a fixed index pointer in a vertical and centered location.
Switch Ratings	Up to 15 amps. at 115 or 230 volts A.C. 20 amp. A.C. or D.C. switches also available.
Switch Types	N.O., N.C., or Double Throw — no neutral position.
On-Off Differential	Approximately 1.0°F. or 2.0°F. dependent on model.
Adjustment	Calibrated dial rotated against a fixed index.
Calibration	Calibrating mechanism permits precise matching of scale to individual tolerance errors of thermal assemblies.
Compensation	Automatic compensation for ambient temperatures.

SEND FOR NEW Catalog 200 for full information on the E32N and other remote bulb temperature controls.

UEI®

United Electric Controls

COMPANY

84 SCHOOL STREET, WATERTOWN, MASS

LITERATURE . . .

Packings, Teflon.....If corrosive liquids or extreme temperatures are causing you packing failures and contamination problems, send for booklet on Teflon packings, ring and envelope gaskets.
346 *Raybestos-Manhattan Inc.

Rectifiers, Silicon.....Features, applications and characteristics for high-current silicon rectifiers listed in data sheet GEC-1470; graphs provide performance data. Sample problem solved.
426A General Electric Co.

Reducers, Speed.....New large-capacity shaft-mounted drive offers reduction ratios of 5:1, 14:1 or 25:1 at torque ratings up to 31,000 lb.-in. For dimension tables and design details get bulletin 7100.
426B Falk Corp.

Reflux Heads & Redistributors..... Automatic reflux heads are explosion proof, electrically operated for high vacuum, pressures and temperatures. Column redistributors are efficient. Bul. 55-1.
BR447 *Distillation Eng. Co.

Rings.....V-rings have greater flexibility and resiliency; cones deform inwardly to seal at the spindle; cups expand outwardly; wedge rings seal at unusually low gland pressure. Catalog AD-155.
327 *U. S. Gasket Co.

Seals, Mechanical.....A superior facing material is now available on the engineered mechanical Dura seal. #55 faced seal rings are long-wearing, operate at high or low temperatures. Bul. 469CE.
B453 *Durametallic Corp.

Seals, Mechanical.....Wedge-Lock line of external and internal mechanical seals is now completely interchangeable in parts, with the exception of the stator bushing. Bulletins CP551 & 575.
R459 *Chem. & Power Products.

Speed Variators.....Bulletin K-200 contains a detailed description of Cleveland speed variators with photographs, sectional drawings, rating tables and specifications. Write for a copy now.
12 *Cleveland Worm & Gear.

Support Plates & Distributors.....New liquid distributors, Weir-Flow for medium to high liquid rates, and Multi-Level for low to medium rates, are described in Bul. TA-30. Also support plates.
132 *U. S. Stoneware Co.

Switches.....Booklet describes how low cost Micro Switch line can be used for dependable, economical control; gives technical data on each switch and shows typical applications.
426C
Minneapolis-Honeywell Regulator.

Thermocouple Wire.....Company makes and stocks a countless variety of thermocouple and extension wires, both solid and stranded conductors, for any application, for all conditions. Bulletin 31-E.
B452 *Thermo Electric Co.

Transformers.....Company offers a list of manufacturers who supply Dow Corning silicone-insulated dry-type transformers. Lightweight, space-saving, easy to install. Maximum reliability.
58 *Dow Corning Co.

* From advertisement, this issue

New ALUNDUM* 33-I Insulating Castable

Mixes and pours like concrete . . . protects up to 3300°F.

With ALUNDUM 33-I the ceiling of protection provided by insulating castables goes up to a new high. It is the most effective castable you can get for insulating at temperatures up to 3300°F. This new Norton refractory B̈ provides maximum protection and quick, easy installation in many types of furnaces and other high temperature equipment.

Easy To Install And To Store

ALUNDUM 33-I comes in dry form, in moisture-protective bags. It mixes readily, in about five minutes — you just add water according to instructions. The consistency of the mix is as workable as any cement mix, and can be easily poured into any prefabricated form.

For full particulars, see your Norton Refractories Engineer. Or write to NORTON COMPANY, 511 New Bond Street, Worcester 6, Massachusetts.

NORTON
REFRACTORIES

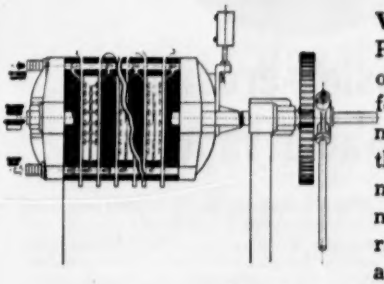
Engineered... Rx ...Prescribed

Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives • Sharpening Stones • Behr-cat Tapes
*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

WHY THE SPERRY FILTER PRESS IS THE MOST POPULAR AND MOST PROFITABLE METHOD OF FILTRATION

Superior Performance—The Sperry Filter Press can thoroughly wash the cake while it's still in the filter press chamber . . . deliver the filtrate to a higher level than the filter . . . filter emulsions . . . deliver the driest cake . . . and produce an outstanding product of uniform purity and stability.



Versatility—Sperry Filter Presses are made in a variety of models and capacities . . . for use with any type of filter media or filter aid . . . to handle the widest range of filterable mixtures, including viscous materials . . . under a wide range of operating pressures and controlled temperatures.

Economy—Sperry Filter Presses are low in first cost . . . low in upkeep . . . low in installation costs . . . low in operating costs . . . low in depreciation . . . and long in life.

Sperry engineers are always available to put all the advantages of the Sperry Filter Press to work for you. Write today for an analysis of your particular filtration problems, or ask for your free copy of the SPERRY FILTRATION CATALOG, containing specifications and other technical data for your reference.

D. R. SPERRY & CO., BATAVIA, ILLINOIS

Filter Plate Presses • Closing Devices • Filter Bases

See Sperry at Booth 1362, 26th Exposition of Chemical Industries Dec. 2-6, 1957

Sales Representatives

George S. Tarbox 808 Nepperhan Ave. Yonkers, N. Y.

B. M. Pilhashy 833 Merchants Ex. Bldg., San Francisco, Cal.

Alldredge & McCabe 847 E. 17th Ave. Denver, Colorado

Texas Chemical Eng. Co. 4101 San Jacinto, Houston, Texas

D. R. SPERRY & COMPANY
Batavia, Illinois

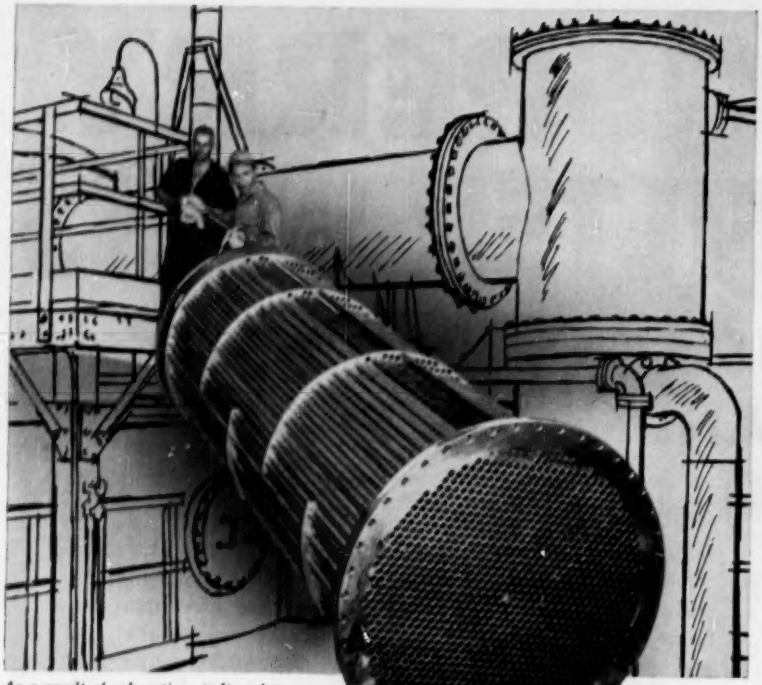
☐ Send Free Sperry Catalog
☐ Have your Representative Contact us

Name_____

Company_____

Address_____

City_____ State_____



As a result of exhaustive studies, Ampco Metal Grade 8 is standard for replacement tubes in these surface condensers, at this major petro-chemical company.

Reduces corrosion-erosion of 5% sulfuric-acid vapors

On-job tests prove deterioration rate for Ampco Metal tubing one-third lower than for copper

The cooling of overhead acid vapors discharging from an H_2SO_4 concentrator spelled trouble for one petrochemical company. After six months, the top ends of the copper tubes in surface condensers had deteriorated due to corrosion-erosion. It was decided to test other materials in this service.

In one 34-day test, specimens were placed at the entrance to the tubes. Results showed that Ampco Metal Grade 8 would give about 50% longer service than the original copper tubes.

A later 45-day test — with samples placed away from tube sheets to minimize erosion — showed Ampco Metal Grade 8 superior to other copper-base and stainless alloys.

The excellent heat-transfer rate and outstanding corrosion resistance of Ampco Tubing provide highest efficiency in many types of equipment. Write us concerning *your* problem.

Corrosion Rate—IPY	
...in 34-day high-velocity test:	
Copper	0.022
Ampco Metal Grade 8	0.015
Carpenter 20	0.056
...in 45-day corrosion test:	
Ampco Metal Grade 8	0.0046
Aluminum brass	0.009
Silicon bronze	0.018
Type 316 (high Mo)	0.020
Hastelloy B	0.0038
Alleghany	0.008
Nioned	0.0019
In both tests...	
Temperature was 200°—270°	
Acid concentration was 0-5% H_2SO_4	
Data from Chemical Engineering, Feb., 1957	

P1-3

For ready reference, see the 12-page Ampco insert in Chemical Engineering Catalog.

AMPCO

AMPCO® THE METAL WITHOUT AN EQUAL

AMPCO METAL, INC., Dept. CE-11, Milwaukee 46, Wis., West Coast Plant: Burbank, Calif.

LITERATURE . . .

Tubes.....Two new booklets, "Industrial Tubes" and "Guide to Replacement," are now available; former gives tube characteristics and latter lists basic designation, class and type numbers for over 100 tubes.
428A Sylvania Electric Products.

Turbines.....Both the regular type wheel and the wide bucket "L" type wheel give high quality and low maintenance cost. Range from 150 hp. down to fractional. Send for free Bulletin 135.
81 *Coppus Eng. Co.

Turbines.....Elliott YR single-stage turbines have a true centerline support, weather-proofed, reliable covering system, liner type bearings, accessible shaft seals. Request Bulletin H-22B.
315 *Elliott Co.

Turbines, Solid Wheel.....Terry solid wheel turbines have rugged, one-piece wheel, large radial and axial clearances, individual nozzle control, dependable, durable governor. Bulletin S-116.
92 *Terry Steam Turbine.

V-Belts.....Roll lot V-Belts offer a quick temporary replacement when endless V-Belt breakdowns occur; tight-holding metal end fasteners insure efficient operation. Literature brings sizes and details.
428B Boston Woven Hose & Rubber.

Handling & Packaging

Bridge Ramps.....Bulletin 310-30 gives data for Roll-Rite bridge ramps; feature all steel welded construction, positive safety lock to prevent creep and two lifting stirrups to prevent dangerous swing.
428C Roll-Rite Corp.

Conveyor.....Gravity conveyor can be used for medium duty in handling boxes, crates, drums and cans. Also handles "problem" items like kegs, light steel bars and light lumber. Ask for bulletin RR-57.
428D Rapids-Standard Co.

Conveyor Belts.....New manufacturing process equalizes stress in each belt ply and leads to longer belt life. Literature available describing the development and what it means to the belt used.
428E Boston Woven Hose & Rubber.

Conveyor Belt, Wire.....Slab, sheet, pelletized and coarse granular materials can be continuously washed, dried, heated or cooled while moving on woven wire conveyor belts. Reference Manual.
358 *Cambridge Wire Cloth Co.

Conveyors.....Airstream conveyors are push-button controlled by one man, move bulk materials swiftly and automatically through smooth-walled pipelines to any corner of the plant. Bulletin 530.
378 *Draco Corp.

Drum Cleaner.....Dirt, rust and paint removed from drum exteriors, lids and interiors quickly with automatic drum cleaning machine. Complete information on construction and operation in bulletin 220.
428F Pangborn Corp.

* From advertisement, this issue

Drums, Corrosion-Resistant.....New line of drums and buckets coated with a vinyl plastisol listed in a new bulletin. Ideal for acids, caustics, plating solutions and all types of corrosives.
429A Michigan Chrome & Chem.

Exhaust Purifiers.....Unit oxidizes carbon monoxide, fumes and odors from gasoline, LP-gas and diesel-powered equipment; can be fitted to exhaust of anything from fork trucks to heavy construction equipment.
429B Oxy-Catalyst Inc.

Loaders.....Company offers Catalog 948 on their box car loader, Catalog 854 on their "Hi-Type" Swiveloader, and Catalog 60 on complete line of in stock materials handling products.
107 *Stephens-Adamson Mfg. Co.

Pails, Acid.....Ace-Hide acid pails are made of a rubber-plastic material that is tough, resilient and suitable for handling most acids and alkalis. 3-gallon size. Write for dealer's name.
333b *Amer. Hard Rubber.

Scales, Truck.....Toledo Hi-Weigh truck scales can prevent overweight fines and delays, protect equipment and prevent cargo damage en route, prevent weighing erors and loss of revenue. Form 2417.
368 *Toledo Scale Co.

Screens, Vibrating.....Bulk material handlers engaged in screening, scalping and washing granular material will be interested in bulletin 757. Gives technical data, applications and specifications for S-A screens.
429C Stephens-Adamson Mfg. Co.

Tanks, Chemical Storage.....In addition to carbon and stainless steel, the company also fabricates and erects tanks, pressure vessels and process equipment of aluminum and special alloys. Tank Talks.
BR451 *R. D. Cole Mfg. Co.

Tanks & Vessels, Aluminum.....New brochure "Reynalds Aluminum for Tanks and Vessels", gives a full list of products that can be stored or handled by aluminum and specific design data and tables.
65 *Reynolds Metals Co.

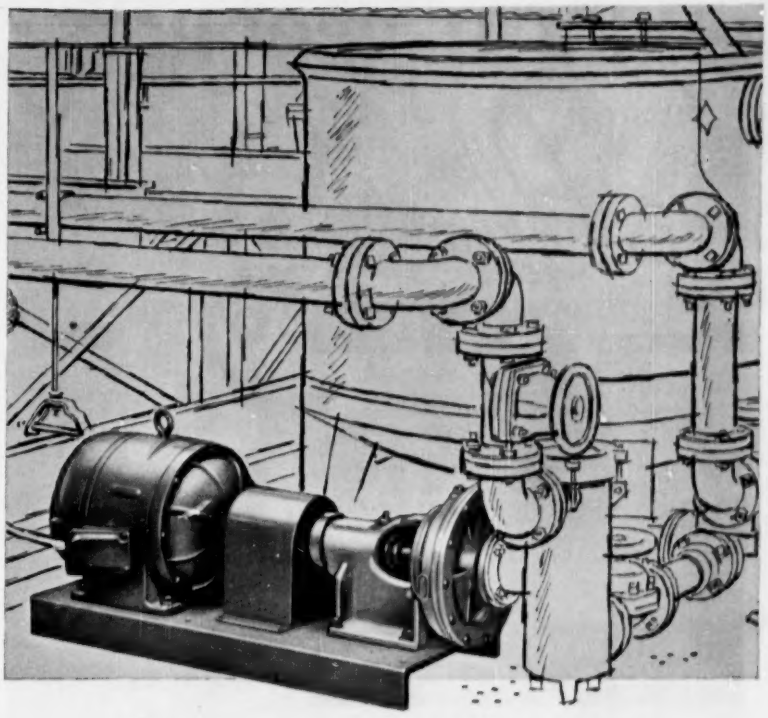
Trucks, Electric Fork.....Measuring only 60", PUG model fork trucks have 52" turning radius; available in 1,000, 2,000 and 3,000 lb. capacities. Additional information is supplied by company.
429D Hustler Corp.

Trucks, Fork.....Engineering, design and construction features of new Allis-Chalmers FT-100 lift truck are outlined in bulletin BU-334A. Specifications also cover various models of the 230 cu. in. engines.
429E Allis-Chalmers Mfg. Co.

Trucks, Fork.....Walkie-type electric-driven industrial trucks, low lift fork loading—4,000 and 6,000 lb. capacity. Pallet-Chek holds pallet firmly while fork enters. Bulletin 1008-W brings details.
421F Automatic Transportation Co.

Heating & Cooling

* From advertisement, this issue



Centrifugal pump resists erosion, corrosion, velocity-turbulence

It's an AMPCO®

Made from aluminum bronze, other workable metals, and non-metallic materials that resist the action of corrosive, abrasive media. Impellers and volute shapes are designed to reduce internal turbulence and liquid-metal boundary velocities.

Ampco Pumps are available in more than 108 different combinations, with speeds from 1750 to 3500 rpm; capacities to 600 gpm; heads to 300 feet. When process conditions change, you can alter your Ampco Pump to satisfy new requirements, easily and inexpensively.

A distributor near you has Ampco Centrifugal Pumps *in stock* — at no premium price.

Also available in
316 Stainless and Elastomers
...FROM STOCK!

See us in New York — Booth 412

AMPCO

AMPCO® THE METAL WITHOUT AN EQUAL

AMPCO METAL, INC., Milwaukee 46, Wisconsin, West Coast Plant: Burbank, California

P-33

NUGENT PRODUCTS

FOR THE *Chemical Industry*

BAG-TYPE FILTERS

These Nugent bag-type filters are ideally suited for filtering amine solutions such as Monoethanolamine, Diethanolamine, and Diethylene-Glycol. Also adaptable for other corrosive substances. All metal parts of the filter cartridge are stainless steel, providing excellent corrosion resistance. Will remove foreign solids as small as .0007" while filtering all the fluid in circulation every cycle. Available in single or duplex models in a wide range of sizes.

Fig. 1116HA-4L

STAR-SHAPED EXTENDED AREA STRAINERS

Nugent star-shaped extended area strainers are offered with brass, steel or stainless steel screens for corrosive service. Available in single and duplex models with wide capacity range.

Strainer Fig. 1490AM-O uses Fig. 1490AW-O basket. Rated for 50 psi working pressure. Capacities: 12-25 GPM. 100 mesh or coarser.

Fig. 1490W-4R, 4S and 4L are high pressure strainers rated for 600 psi working pressure. Use Fig. 1490CN baskets of corresponding size. Capacities: 65-468 GPM. 100 mesh or coarser.

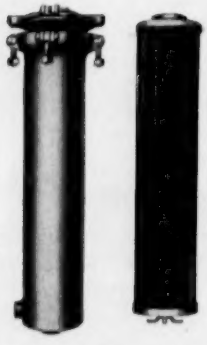
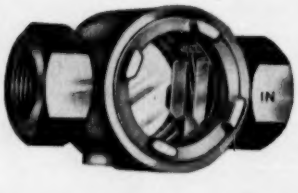


Fig. 1490DD-4L strainer uses one 1490CN-4L basket. Sizes 4R and 4S are same style. Larger sizes available. 125 psi working pressure. Capacities: 65-7500 GPM. 100 mesh or coarser.

SIGHT FLOW INDICATORS

Fig. 1366E fittings are for indicating the flow of liquid in a pipe line. Has spring compensated, hinged, indicator gate which moves in proportion to the flow and is visible from either side, even when liquid is dark or discolored. Windows easily removed for cleaning. May be supplied with electrical contacts to operate an alarm bell or light if liquid flow should stop. Available in brass, cast iron, steel or stainless steel.



For complete information send outline of your requirements.

ESTABLISHED 1897

REPRESENTATIVES IN PRINCIPAL CITIES

WM. W. NUGENT & CO., INC.

3458 CLEVELAND STREET, SKOKIE, ILLINOIS

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

LITERATURE . . .

Boilers.....If space is a factor in your boiler needs, send for a free ¼ inch scale template of complete vapor modulatic water tube boiler line, making planning simple. Also Bulletin 586.
187 *Vapor Heating Corp.

Boilers.....Brochure is now available describing new high-efficiency steam boilers; require ⅛ less space than conventional boilers and improved design reaps real operating economies.
430A Pastushin Industries Inc.

Burners, Industrial.....New 12-page catalog features burners for gas, oil or combination firing; greater efficiency and operating safety. Complete with combustion control and forced draft air system.
430B Coen Co.

Coils, Heat Transfer.....Aerofin type R removable-header water coils are designed for installations where frequent mechanical cleaning of the inside of the tubes is required. Bulletin R-50 offered.
360 *Aerofin Corp.

Condenser Tubes.....Trufin one-piece, finned condenser tubes are not affected by varying temperatures, fluctuating pressures, constant vibration. Available in many sizes and types. Trufin Catalog.
68B *Wolverine Tube Div.

Condenser Tubes.....“Comparative Heat Exchanger Costs” book graphically presents cost breakdowns and comparisons between the use of plain tube and integrally finned tube in heat transfer design.
68A *Wolverine Tube Div.

Condensers.....Aero vapor condenser, using air as the cooling medium, produces a higher vacuum than other type condensers, and with more economy of power and steam. Request a copy of Bulletin 129R.
420 *Niagara Blower Co.

Condensers, Surface.....Illustrated bulletin describes new line of SWECO surface condensers—designed for efficient vacuum production in prime mover service with large steam turbines. M-571.
430C Southwestern Engineering Co.

Coolers.....Horizontal core atmospheric coolers are capable of meeting a wide range of cooling requirements. They have round tube cores, monobloc tube construction, removable cover plate. Cat. 550.
448 *Young Radiator Co.

Desuperheater.....Innovation in desuperheater design described in bulletin 1037. Presents specifications, constructional design features and shows hook-up for use in a pressure-reducing station.
430D Blaw-Knox Co.

Ejectors, Steam Jet.....An 8-page bulletin describes and illustrates design, construction, sizes, combinations and uses of Sweco steam jet ejectors, with Dalton's Law charts. Bulletin M-4-32.
322 *Southwestern Eng. Co.

Filling, Cooling Tower.....Reprints of “Comparative Performance of Cooling Tower Packing Arrangement” and brochure “Answers to 15 Questions About Pritchard Induced Draft Cooling Towers”.
90 *J. F. Pritchard Co.

* From advertisement, this issue

Generators, Packaged Steam.....FW packaged steam generators are available in capacities from 10,000 to 62,500 lb/hr and pressures to 1300 psi. Complete information in Bulletin PG-55-3.
161 *Foster Wheeler Co.

Heat Exchangers.....Alcotwin heat exchangers give flexibility, economy in grst cost, in ease of installation and maintenance. You can select the precise metallurgy needed. Bulletin FH-3.
389 *Alco Products, Inc.

Heat Exchangers.....You can get a fixed tube heat exchanger delivered to your plant in just two weeks from your order date, or four to six weeks with larger sizes. etails in Bulletin 949.
168-9c *Pfaudler Co.

Heat Exchangers.....Company makes all four basic types of heat exchangers: shell and coil, shell and tube, shell and tube bundle, and atmospheric, in every possible modification. Buls. 427 and 707.
447 *Vilter Mfg. Co.

Heaters.....Thermal liquid heaters have forced recirculation, accurate temperature control, high heat transfer rates and low cost, low pressure operation. Send for factual Bulletin TLH.
424 *International Boiler Works.

Heaters.....Products Catalog 956 contains the complete story on Grid unit heaters, blast heaters and Grid radiation for chemical plant use. Cast iron steam heat transfer surface for efficiency.
L458 *D. J. Murray Mfg. Co.

Heaters.....Commercial and industrial unit heaters are featured in new booklet; details construction and application of new line of heaters. Many illustrations and tables. Request booklet B-1523.
431A Westinghouse Electric Corp.

Heaters, Drum.....Four sizes—16, 14, 30 and 55 gal.—drum warmers now available. Electrically heated, 60-450 F. temperature ranges; allows easy access to top of drum. Write for literature.
431B H. L. Palmer Co.

Thermo-Panels.....Bulletin 355 has complete facts on Dean Thermo-Panel Coils, while Bulletin 257 gives price and design data and Form DW-6 covers drum warmers. Available on request.
TR462 *Dean Products Inc.

Towers, Cooling.....Extend cooling tower life: use Mersemetric pumps to meter chemicals to cooling water and fight corrosion. Data sheet D-57-1 details several low-cost water treating systems.
431C Milton Roy Co.

Traps, Steam.....Nicholson steam traps have a powerful, intermittent valve action which closes the valve completely, with no steam waste, no dribbling. Send for a copy of Bulletin 1056.
88 *W. H. Nicholson & Co.

Traps, Steam.....44-page Armstrong Steam Trap Book covers other features of company's steam traps as well as their excellent air handling characteristics. Deals with selection and installation.
113 *Armstrong Machine Works.

* From advertisement, this issue

VISCOSITY

A product dimmension as important as Ph, color or stability. Accurate viscosity control turns chance to science — waste to wealth.

BROOKFIELD

The name you can depend on when you see it on any viscosity measurement or control instrument.

YOU AND THE CHEM SHOW

You are a scientist, the coming Chem Show will be our meeting ground. Booth #885-87 will conveniently show in live operation the Brookfield Viscometran now in use successfully for polymerization end point determination and continuous "in process" viscosity recording. See and try, the famous Brookfield viscometers in a broad range of models, look over the many Brookfield accessories which give the Brookfield viscometer its famous flexibility. At the Chem show, anytime, make Brookfield your first source for viscosity information.

The world's standard for viscosity measurement and control

Brookfield know how is yours for the asking without obligation

Brookfield

ENGINEERING LABORATORIES INCORPORATED

STOUGHTON 13, MASSACHUSETTS

CORROSION PROBLEMS?

NO PROBLEM HERE
—WITH STRICK'S

LAMICOR

Combining High Corrosion and Chemical Resistance and Outstanding Structural Strength in a lightweight material that has the workability of wood.

- Satisfactory for continuous service with acids, most alkalis and solvents in a wide temperature range.
- Sheet Sizes up to 50" x 102"
- Any thickness up to 1½"
- Efficient Thermal Insulator
- Will not rot, rust, crack, peel or chip.
- Excellent Dimensional Stability
- Smooth easily cleaned surface—no product contamination.

Lamicor's unique combination of good chemical, mechanical, thermal and electrical qualities now makes a single material construction possible wherever corrosion is a problem. Lamicor obsoletes the need for expensive multi-material construction such as the combination of wood for lightweight, metal for strength and glass for corrosion resistance . . . Lamicor has all three advantages and more. Long service life means considerable savings too! Write for free samples, technical information and a solution to your particular problem.

A complete source of supply for Lamicor sheets, channels, angles and fabricated parts.

STRICK PLASTICS

PERKASIE, PENNA.

Basic Material Producers of Plastics and Laminates

Custom Vacuum Forming—Specialists on Extra Large Forms

Product Engineering and Development in Plastics and Laminates

Composite Structures and Honeycomb Panels

LITERATURE . . .

Traps, Steam.....Six-page folder explains how Crane inverted open float steam traps work to remove condensate and leave lines hot and dry; tables for selecting traps for any condensate discharge condition.
432A Crane Co.

Instruments & Controls

Analyzers, Gas.....Thermal conductivity gas analyzer features a gas analysis cell assembly and an electronic Speedomax recorder, with high accuracy, sensitivity, stability. Folder ND46-91(2).
273 *Leeds & Northrup Co.

Analyzers, Gas.....Bulletin 8-57 gives technical data for thermal-conductivity gas analyzer; especially valuable for analysis of Argon and Helium. Instrument features low cost and easy operation.
432B Gow-Mac Instrument Co.

Anemometer Cell.....Electronic cell is a simple device for measuring very low gas flow—50 ml./min. or less; sample may flow in either direction. Use with adjacent or remote sampling point. Model 9580.
432C Gow-Mac Instrument Co.

Comparators, pH.....By making fast, on-the-spot determinations for pH with handy, light weight Taylor Comparators, you can maintain control of chemical operations. "Modern pH & Chlorine Control."
L442 *W. A. Taylor & Co.

Control System.....First packaged remote control system for positioning of final control elements; regulate flow rate, pressure, surge or liquid level at distances up to many miles. Bulletin 982.
432 A. W. Cash Co.

Control Systems.....Limitorque, the final control element, converts any up-stream process variable into a down-stream constant by continuously repositioning the control valve. Bul. -57.
108 *Phila. Gear Works.

Controllers, Limit.....New folder describes in detail the use of Daytronic limit controllers for automatic control of weight, size, force, thickness, pressure or other physical quantities. Bulletin 562.
432E Daytronic Corp.

Controllers, Temperature.....Thermostatic pilot controller No. 1100-C and D enables you to control temperatures up to 600 degrees F with proportional accuracy. Cat. Sheet 10-28VC.
379 *Robertshaw-Fulton Controls.

Controls, Temperature.....Type E32N remote bulb, indicating temperature control features control point accuracy equivalent to that of individually calibrated instruments. Catalog 200.
426 *United Elec. Controls.

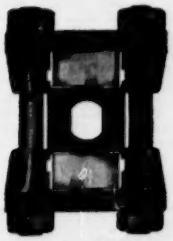
Controls, Temperature.....Precision controller accurate to 0.001 degree C. over a range of —100 C. to 500 C. Electronic bridge-resistance thermometer design; suitable for lab or pilot plant. Bulletin 58.
432F Bayley Instrument Co.

*From advertisement, this issue

Strahman

HIGH PRESSURE GAUGES

USED IN
REFINERIES
AND
CHEMICAL PLANTS
THROUGHOUT
THE WORLD



THRU VISION

REFLEX
Single or Multiple Sections

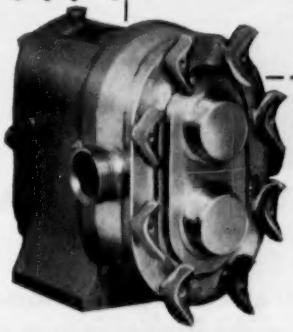
TUBULAR

Gauge Cocks
•
Large Chamber Reflex Gauges
•
Heated or Cooled Gauges

SEND FOR
COMPLETE CATALOGUE

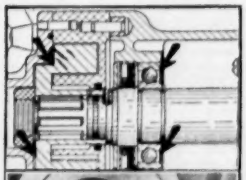
STRAHMAN VALVES, Inc.
16 Hudson St., New York 13, U.S.A.

Get Longer Service at Lowest Maintenance... in High Corrosion, High-Temperature Pumping...with

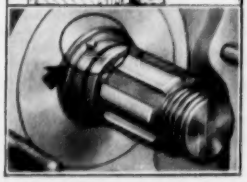


WAUKESHA P.D.* CORROSION RESISTANT PUMPS

Both metallurgically and mechanically, Waukesha P.D. Pumps are designed specifically to meet the rigid demands of the chemical industry in pumping corrosive products under most temperature conditions. The Waukesha Metals used are the result of over a quarter century of pioneering in corrosion-resistant formulas, including stainless steels. And, mechanically, there are at least *eighteen* reasons for the longer service and lowest maintenance already proved in the industry. These "reasons" include such important factors as positive sealing with Twin O-Rings, better load-balance between shafts and heavy duty bearings, larger, stronger shafts, more and huskier splines — for greater rigidity, less wear — and newly designed twin blade impellers for better distribution of the load factor at all speeds and pressures. There are many more new features you'll want to know about.



This drawing shows the close position between the heavy duty ball bearings and the corrosion-resistant impellers — for reduced shaft-slap and wear.



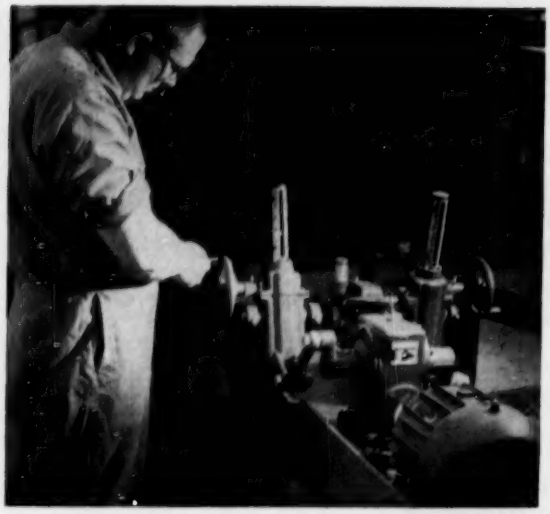
Larger diameter shafts, more and larger splines, plus a new stainless steel shaft seal with positioning pin, assure greater rigidity to impellers and longer service.

This new WAUKESHA 1957 Catalog gives you the whole story. Write for your copy, telling us what product you handle . . . Just a postcard will do.

*Positive Displacement

ONLY Waukesha gives you a quarter century's experience and reliability

Waukesha FOUNDRY COMPANY
DEPT. U-11, WAUKESHA, WISCONSIN



In-Motion Stroke Adjustment offers the ultimate in convenience for controlled chemical feeding. Stroke length adjustable (no tools required) in stepless increment over entire range of pump while pump is in operation!

NEED ACCURATE CHEMICAL FEEDING TO PROCESS?

Check into this economical, efficient, proportioning pump by PROPORTIONEERS!

For greater accuracy, greater range . . . feed all chemicals (alkaline, neutral, or acid) with the Model 1140 Proportioneer. Pay less, get more . . . interchangeable measuring cylinders, super-accurate Vane-Guide check valves, percentage calibrated stroke-length scale, etc.

- Accuracy—within ±1%
- Capacities—from 0.8 GPH to 900 GPH
- Adjustment range—15 to 1
- For discharge pressures up to 1340 psig

MODEL 1140 PROPORTIONEER					
Discharge Pressures up to	MAXIMUM CAPACITY PER CYLINDER IN GPH* (Minimum feed rate 1/15th of max. cap. by stroke length adjustment)				
1340 psig.	10.7	13.3	17.8	21.3	26.6
670 psig.	20.9	26.1	34.8	41.8	52.2
335 psig.	42.7	53.3	71.1	85.3	106.5
168 psig.	83.6	104.4	139.2	167.1	209.0
84 psig.	171.0	213.0	284.5	342.0	426.0

*Five operating speeds available for various fluid viscosities. For capacities of DUPLEX MODELS (see photo), double the capacities shown in table. If you need capacities and pressures other than these, consult Proportioneers, Inc., manufacturer of the most complete line of proportioning pumps.

Free Bulletin

Request Bulletin No. 1140 for complete data. Write to PROPORTIONEERS, INC., 369 Harris Avenue, Providence 1, R. I.

PROPORTIONEERS, INC.
DIVISION OF
B-I-F INDUSTRIES
PROVIDENCE, RHODE ISLAND
METERS FEEDERS CONTROLS

LITERATURE . . .

Controls, Temperature.....Two-position, thermocouple signalling controller provides low-cost electronic control for processes where a record or continuous indication is not required. Data sheet ND47-33(1).
434A Leeds & Northrup Co.

Controls, Temperature.....Equipment measures and controls firing temperature for rotary kilns. Data sheet 705(2) describes advantages and illustrates all details of this control system.
434B Leeds & Northrup Co.

Controls, Weight.....New 20-page bulletin on weighing of bulk material is first comprehensive coverage of instrumentized weighing to be published. Included is W-C line of weighing equipment. Bulletin 12.
434C Weighing & Control Components.

Electric Eyes.....Bulletin 570 describes uses of electric eyes as an aid to automation in the processing industries; includes drawings of typical installations and capsule descriptions of these instruments.
434D Ess Instrument Co.

Flowmeters.....More than twenty proven materials for corrosion-proof end fittings and floats, stainless steel enclosures, neoprene backed Teflon packing liners. Flowrator Catalog 10-A-25 offered.
153 *Fischer & Porter Co.

Gages.....Company offers catalog on Supergauge, the Solfrunt solid front gage for maximum safety, the diaphragm receiver gage and the pressure pilot, all designed for the best process efficiency.
353 *U. S. Gauge Div.

Instrument Tubing.....Armored Multitube, a corrosion proof polyvinyl chloride sheath over spirally cabled copper or aluminum instrument tubing, protects against moisture, corrosion. Bul. 356-H.
B327 *Crescent Insulated Wire.

Instruments.....Catalog 54-766-38 describes principle, construction and operation of Veriflow positive displacement meters and Veritrol flow controllers. Control water, molasses, sulphuric acid, etc.
434E Hays Corp.

Meters.....Bulletin NI-57 contains 12 pages of cost-saving metering information, including a number of case histories. Also included are installation suggestions and maintenance rules.
434F Neptune Meter Co.

Meter, B.T.U.....Mechanical instrument measures heat flow in B.T.U.'s and liquid flok in gallons with high precision. Can be used in metering of central heating and refrigeration units. Bulletin 1000.
434G Air Conditioning Equipment Corp.

Proportioning Equipment.....Waytrol automatically weighs and delivers exact quantities for mixes going into every kind of product. Control is electrical, with instant response. Catalog 841 offered.
118 *Jeffrey Mfg. Co.

Pyrometers.....Alnor pyrometers are designed to give consistently accurate temperature readings under the most severe conditions of vibration, dirt and corrosive atmosphere. Bulletins 4371. 4361.
L451 *Illinois Testing Labs.

* From advertisement, this issue

Recorders.....American-Microsen Series 130 recorders have simple design, precision components and rugged construction for sustained accuracy and freedom from maintenance. Bulletin MG10.
98 *Manning, Maxwell & Moore.

Safety Controls.....New 24-page booklet covers basic safety controls for all low-pressure steam boilers; tells the "how" and "why" of all authoritative methods of providing maximum boiler safety.
435A McDonnell & Miller Inc.

Thermocouple Gland.....New design provides positive seal for pressures from 0.005 microns to 5,000 psi. and temperatures from —300 F. to 1850 F.; stainless steel construction. Bulletin MTG.
435B Conax Corp.

Transducers.....Company offers complete line of transducers for remote indication, measurement and control of pressure; use with wide variety of indicators and recorders. Data sheet gives characteristics.
435C H. E. Sostman & Co.

Transmitters, Liquid Level.....A differential pressure liquid level transmitter mounted directly on a tank nozzle measures viscous or slurry-type liquids in open or closed vessels. TD 1285.
293-4g *U. S. Industrial Chem. Co.

Transmitters, Pneumatic.....Rangeability of pneumatic transmitters has been increased as high as 20:1 while reducing size and weight. Also features simplified recalibration procedure. Folios 56-12 and 56-13A.
435D Republic Flow Meters Co.

Transmitters, Pressure.....Taylor volumetric differential pressure transmitter is isolated from process material. Ideal for slurries, corrosive liquids, colloidal suspensions. Bul. 98281.
50-1 *Taylor Instrument Co.

Valve Operators.....Adaptable to wide range of control requirements; use with air, gas, oil or water at pressures up to 200 psi. Details of these operators including dimensions given in bulletin 3040.
435E Ledeen Mfg. Co.

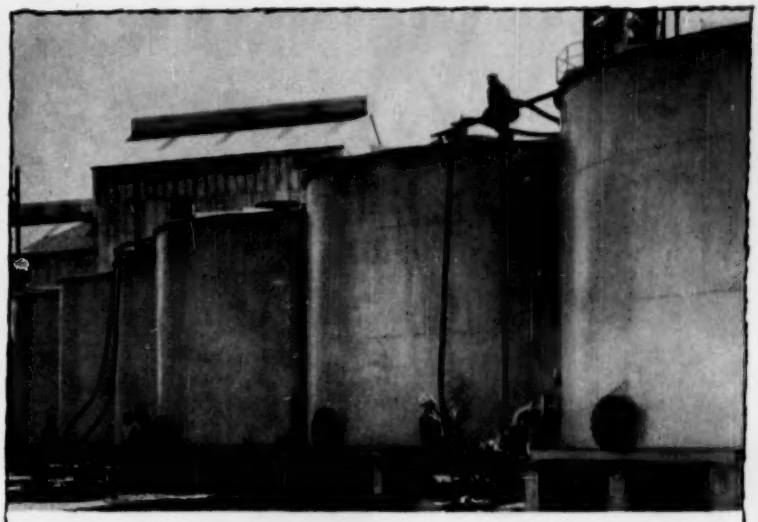
Pipe, Fittings, Valves

Couplings.....Steelflex couplings, Type F, are versatile, efficient and economical; they fill 90% of all industrial application needs. Send for a free engineering bulletin with selection tables.
94 *Falk Corp.

Couplings.....Patented re-usable couplings are fitted without heat by a simple, clean mechanical process, accomplished in minutes. Hand machined of top quality brass. Bulletins DC and IND-4.
338 *Packless Metal Hose.

Hose, Flexible Metal.....Atlantic flexible stainless steel hose stands up in any inferno of high temperature and high pressure corrosive gases and liquids. Leakproof, durable. Bul. 21-A.
55 *Atlantic Metal Hose.

* From advertisement, this issue.



From Engineering to Erection . . .

BOARDMAN produced these acid tanks for CHEMICALS OZARK MAHONING

Here was a typical metalcrafting job which made use of BOARDMAN's 46 years' experience all the way from the drawing board to in-place completion. Ozark-Mahoning's Tulsa, Oklahoma chemical fertilizer plant needed phosphoric acid storage tanks. Starting with the customer's specifications, BOARDMAN contributed suggestions for improved design . . . engineered the tanks . . . fabricated them of carbon steel, with special welding to permit rubber lining . . . and then erected the units. Other dependable BOARDMAN metal products on this job include a 100-foot steel stack and a connecting fume disposal incinerator.

No matter what your metalcrafting requirements may be, it will pay you to investigate BOARDMAN's outstanding facilities and know-how. At your request, a BOARDMAN sales-engineer will fly to your office for direct consultation.

Working with metal is a specialty at . . .

BOARDMAN

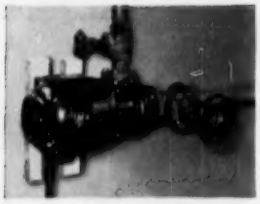
THE BOARDMAN CO.
OKLAHOMA CITY, OKLAHOMA

Write for the brochure "Working with Metal . . . at Boardman."

FROM WEINMAN...

Here and Now . . .

A REMARKABLE, ALL-PURPOSE PUMP



Efficient, dependable, truly versatile . . . WEINMAN General Service Unipumps are America's finest economical, general purpose pumps.

Complete adaptability permits peak operating efficiency in *any position* . . . mounted horizontally, vertically, on floors or walls. So compact they install easily in a minimum of space. Truly, here is a pump for every application.

Available with enclosed or open type impeller . . . horsepower range, ½ to 50 . . . heads to 260 feet . . . capacities to 1800 gpm! Thousands are already in use, efficiently serving industrial, municipal and residential installations.

See your WEINMAN Pump Specialist for full information on WEINMAN General Service Unipumps. He'll be glad to help you with your pumping problems. His name is listed in the yellow pages of your telephone directory.

Write today, for *your free copy* of WEINMAN'S illustrated Bulletin 300, showing specifications, dimensions, construction features and *complete selection table* for WEINMAN General Service Unipumps.

THE **WEINMAN PUMP** MFG. CO.
290 SPRUCE ST. COLUMBUS 8, OHIO

Centrifugal Specialists

LITERATURE . . .

Hose, Teflon.....R/M flexible thin-wall Teflon hose is supplied in two forms: stainless steel wire braided or rubber covered. Wide range of inside diameters and wall thicknesses. Bulletin 6700.
128 *Raybestos-Manhattan Inc.

Joints, Expansion.....Free-flexing and controlled-flexing; dual and multiple types; balanced joints and other special designs; all in stainless steel and other workable alloys. Design Guide.
354 *Flexonics Corp.

Nozzles, Spray.....Choose the spray nozzles that give ou proper performance with exact spray pattern, impact, spray angle and capacity; be sure they are produced to close tolerance. Cat. 24.
TR451 *Spraying Systems Co.

Nozzles, Spray.....Yarway spray nozzles are available in two types, Involut for fine hollow cone spray with minimum energy loss, and Fan-spray for flat, fan-shaped spray. Bulletin N-618.
L462 *Yarnall-Waring Co.

Nozzle, Spray.....Designed primarily for manifold installations, spray nozzle has manually operated shut-off assembly; fabricated from brass with internal monel metal strainer. Data sheet 6033.
436A Spraying Systems Co.

Pipe Cutter.....Developed to cut thin-wall, large-diameter tubing, cutter also gives finely finished end cut for heavy pipe and solid material. Brochure brings details of Roll-A-Round cutting unit.
436B Wallace Supplies Mfg. Co.

Pipe, Glass.....Only hydrofluoric acid and hot, concentrated alkalis above pH 12 can corrode Pyrex glass pipe. You can see through it; you can run liquids hot. No scale build-up. Bulletin.
218-9 *Corning Glass Works.

Pipe Hangers.....Blaw-Knox trapeze functional spring hangers, with patented internal swivel action, support power piping in a new generating station. Further data available in Catalog 54.
66b *Blaw-Knox Co.

Pipe, Plastic.....General purpose, moderately priced rubber-plastic pipe handles most common chemicals to 170 deg. F, except a few strong acids and organic solvents. Bulletin 80 offered.
332b *Amer. Hard Rubber Co.

Pipe, Plastic.....Ace Riviclor is a rigid threaded plastic pipe with good aging and high impact strength. Not affected by most inorganic acids and alkalis. Request Bulletin CE-56 now.
332e *Amer. Hard Rubber Co.

Pipe, Polyvinyl Chloride.....Polyvinyl chloride pipe comes in 2 types: Normal Impact, where very high chemical resistance, strength and creep resistance are needed, and High Impact. Bulletin 24.
386 *U. S. Steel Corp.

Pipe, Pyrex Glass.....Bulletin PE-30 lists over 100 troublesome chemicals handled in Pyrex pipe. Shows typical drain line installations in chemical plants and gives fitting and installation data.
436C Corning Glass Works.

* From advertisement, this issue

Pipe & Tubing, Stainless Steel..... New 48 page illustrated book covers analysis & conversion tables, corrosion characteristics, weights, alloy properties, bending, joining & installation hints.
197 *Trent Tube Co.

Piping.....Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available. Request Bulletin 2443.
66C *Blaw-Knox Co.

Piping.....Flori skill and experience is displayed in the largest alloy pipe fabricating project ever undertaken, the Tidewater Oil Company's gigantic Delaware Refinery. "How Piping is Fabricated".
128 *Flori Pipe Co.

Tubing, Carbon Steel.....Production and design engineers will want bulletin TB-419. Explains advantages of electric-resistance-welded mechanical tubing. Detailed information on properties and sizes.
437A Babcock & Wilcox Co.

Tubing, Plastic.....Ace-Flex is an excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic. Send for a copy of Bulletin 66.
332d *Amer. Hard Rubber Co.

Tubing, Plastic.....Reinforced plastic PVC tubing will bend around a 5/16" diameter spindle without reducing internal bore. Bardex reresists gasoline, oils and sea water; lightweight. Ask for data sheet.
437B Newage International Inc.

Tubing, Stainless.....Carpenter stainless tubing and pipe have proved their ability to stand up under increased temperatures and thruput, with cost reductions. Selecting & Buying Guide.
209 *Carpenter Steel Co.

Tubing, Steel.....Designers of equipment using tubular products at elevated temperatures will want data card 153-B. Contains stress rupture data on fourteen steels used in such services.
437C Babcock & Wilcox Co.

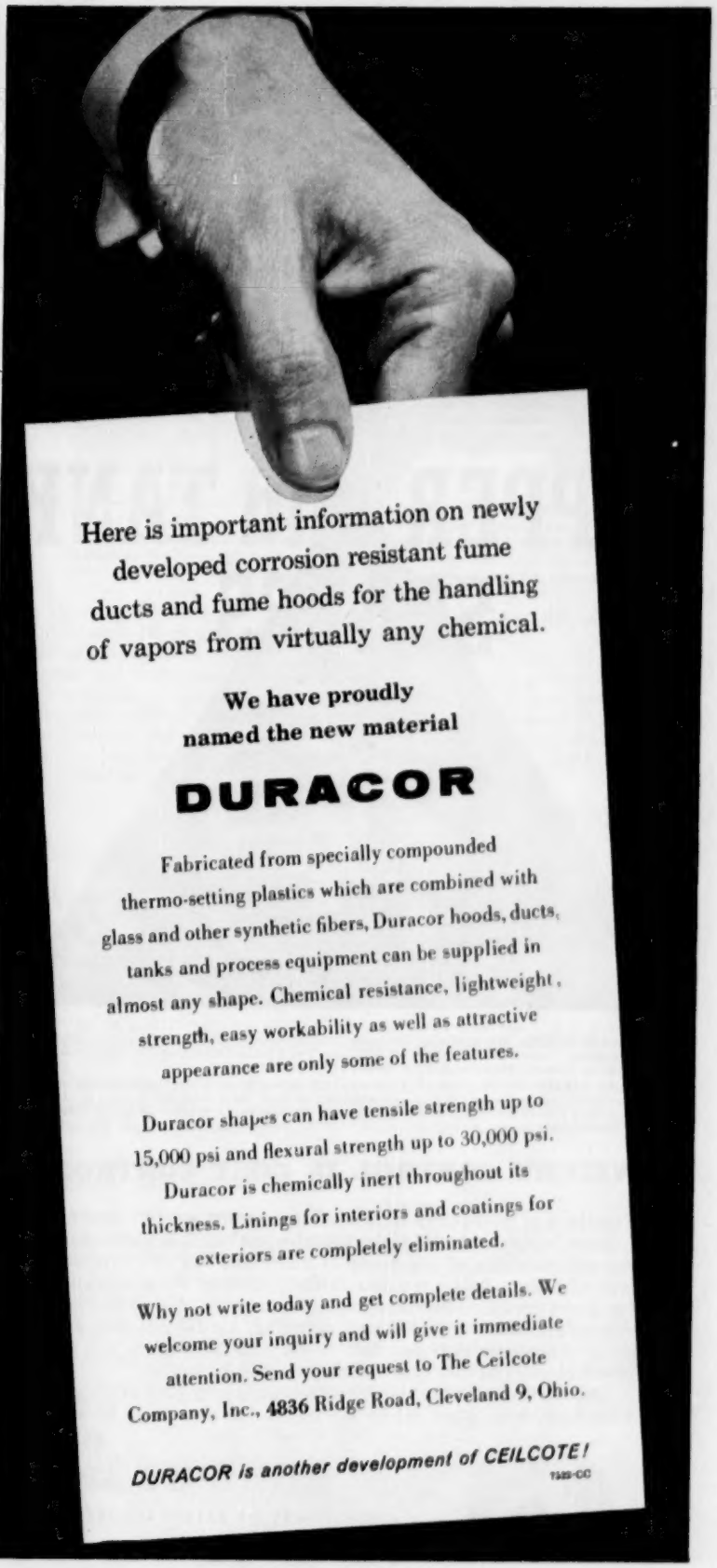
Valves.....Company's valve is not an adaptation of earlier brass and iron patterns; it was designed to be cast in sainless steel. Less maintenance, longer life. Design Factors in Stainless Steel Valves.
102 *Cooper Alloy Corp.

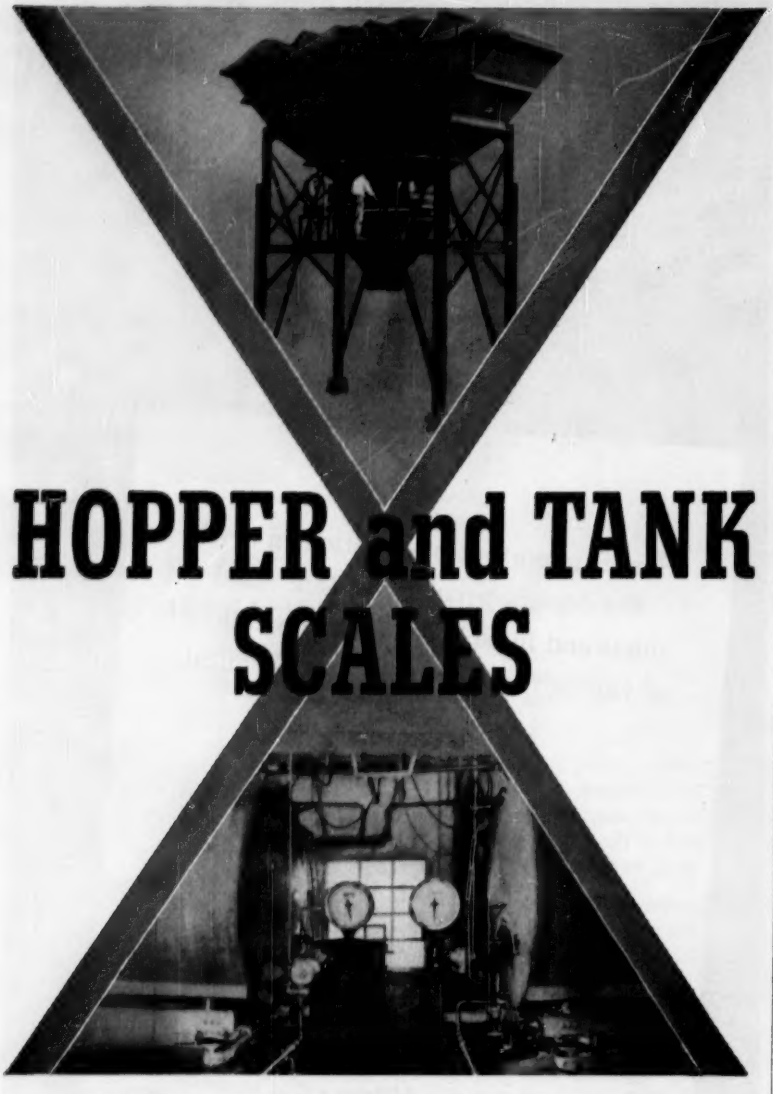
Valves......"Valve Performance Facts" is a 36-page circular of on-the-job economies made with Crance valves, which cut valve maintenance and replacement costs in plants. Request a copy.
227 *Crane Co.

Valves.....There's an Ace hard rubber, rubber-lined or plastic-lined valve for any corrosion application. Diaphragm, gate and check types. Also rubber-lined steel for high pressures. CE-52.
33a *Amer. Hard Rubber.

Valves.....Longer life, less maintenance and process interruption, positive closure, easier operation and self-adjustment for valve body deflection are found in company's valves. Catalog 57.
363 *Darling Valve & Mfg.

* From advertisement, this issue


Here is important information on newly developed corrosion resistant fume ducts and fume hoods for the handling of vapors from virtually any chemical.
We have proudly named the new material
DURACOR
Fabricated from specially compounded thermo-setting plastics which are combined with glass and other synthetic fibers, Duracor hoods, ducts, tanks and process equipment can be supplied in almost any shape. Chemical resistance, lightweight, strength, easy workability as well as attractive appearance are only some of the features.
Duracor shapes can have tensile strength up to 15,000 psi and flexural strength up to 30,000 psi. Duracor is chemically inert throughout its thickness. Linings for interiors and coatings for exteriors are completely eliminated.
Why not write today and get complete details. We welcome your inquiry and will give it immediate attention. Send your request to The Ceilcote Company, Inc., 4836 Ridge Road, Cleveland 9, Ohio.
DURACOR is another development of CEILCOTE!
7525-CC



HOPPER and TANK SCALES

HOPPER SCALES. For batching, charging, proportioning, filling, compounding and processing. Capacities from 500 to 120,000 lbs. For square, rectangular or cylindrical hoppers. Howe lever action assures rugged and accurate service.

TANK SCALES. For all types of tanks mounted vertically or horizontally. Simplified pipe lever system for supporting and weighing all tank loads from 500 pounds to 110 tons. Low corner mounting stands permit easy installation in areas with low ceilings or limited floor space.

WEIGHT CONTROL IS COST CONTROL

Fractions of pounds can be critical in cost and product quality.

Howe hopper and tank scales can give you rapid, accurate mixing and weighing of any group of materials. You can have any type of weight indication you choose—dials or Weightographs for direct readings, Mechanoprint recorders for printed weights, remote printers for centralized weighing, digital readouts and many other special types. And Howe understructures are the proud product of 100 years of skilled scalesmanship.

Additional scales—or better scales—might help your profit picture right now. Find out by talking to the man from Howe.

The HOWE SCALE Co

A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

RUTLAND • VERMONT

LITERATURE . . .

Valves.....Cast steel valves have scientific design, rugged construction, precision finish, carbon steel and special alloys and a selection of trims. Send for "Stockham" and "Wedgeplug" Cats.
381 *Stockham Valves & Fittings.

Valves.....V-7 valve for reciprocating pumps incorporates seven points of superiority, features a tapered or V-shaped stud which screws down tight to the seat. Send for free Booklet CE-117.
421 *Durabla Mfg. Co.

Valves.....Fairbanks Valve Catalog No. 57 covers complete line of bronze and iron body valves. Includes latest additions to valve line and useful technical data—equivalent resistance of fittings, etc.
438A Fairbanks Co.

Valves, Valves, Corrosion Resistant..... Crane alloy valves provide high resistance to corrosion and protection from product contamination. Data on applications, materials, sizes and fittings in Circular 2080.
105 Crane Co.

Valves, Cushioned.....Bulletin G-5 shows particular valve applications: supply water to mill, accurate water level control in reservoirs, and emergency fire protection. Ask for a copy.
438B Golden-Anderson Valve Spec.

Valves, Diaphragm.....Diaphragm valves provide leak-tight flow control for all air, water, liquids, slurries, gases and corrosive services. In-line maintenance. Catalog #104.
326b *Hills-McCanna Co.

Valves, Diaphragm.....Bulletin 800 gives characteristics for a wide line of diaphragm valves for pressure and vacuum service. Series 6200 valves feature exclusive corrosion resistant end.
438C W. S. Rockwell Co.

Valves, Gate.....Jenkins U-Bolt gate valves are priced no higher, and are designed to cost less to use. Provides a bonnet-saving bushing. Iron body with bronze or stainless steel mounting. Folder 207.
317 *Jenkins Bros.

Valves, Lubricated Plug.....You can complete your file of vital valve data by writing for Catalog 400, containing sizes, pressures, specifications, design and performance factors of ACF valves.
119 *ACF Industries Inc.

Valves, Plastic.....Trouble-free plastice valves come in general purpose Ace-ite, Ace Parian (polyethylene) or Ace Saran. Handle most corrosive chemicals and food ingredients. Bulletin 351.
332C *Amer. Hard Rubber.

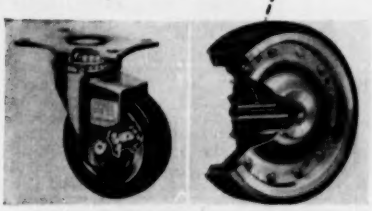
Valves, Regulating.....Company's temperature regulating valves eliminate stuffing boxes by their balanced diaphragm construction. Guaranteed not to wiredraw. Send for informative Bulletin T150.
384 *Spence Eng. Co.

Process Equipment

* From advertisement, this issue

4

good reasons to rely on



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1. **RUBBER TREADS . . . a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage.**

2. **RUST-PROOFED . . . by zinc plating, Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.**

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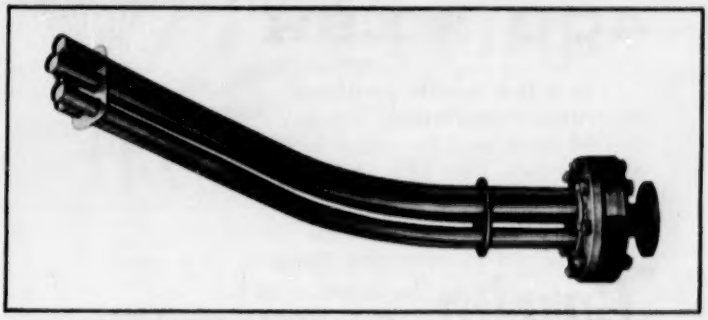
Corrosionomics

REGISTERED U. S. PATENT OFFICE

A JOURNAL OF USEFUL INFORMATION FOR THE SOLUTION OF CORROSION PROBLEMS

Tantalum Equipment in HCl Service



One of several five-tube tantalum bayonet heaters of unusual curved design, which were manufactured to fit a fused silica retort at J. T. Baker Chemical Company, Phillipsburg, New Jersey. The tantalum heaters were installed in the retort in 1937, and after twenty years of severe service are still in use.

A variety of concentrations of hydrochloric acid—ranging from cold to boiling temperatures—puts both production and maintenance equipment to severe tests in the Phillipsburg, New Jersey plant of the J. T. Baker Chemical Company. For this reason, tantalum has long been specified for the fabrication of critical in-line equipment as well as for repair parts.

Tantalum bayonets for heating process liquids, and tantalum condensers for the recovery of highly corrosive vapors find many uses in this type of service. Not only does tantalum show no corrosion under constant exposure to the chemicals in these applications, it also provides exceptionally high heat-transfer characteristics.

Tantalum dip tubes for feeding corrosion gases and liquids to various process equipment have their share in solving difficult corrosion problems, too. Some of this equipment has been in almost continuous operation in the J. T. Baker plant for over twenty years.

Tantalum Repair Parts Extend Equipment Life

Glassed steel vessels are used in many places throughout the plant. This equipment represents a sizeable investment and from the standpoint of economical processing, extended service life is very important. The life of these vessels has been materially increased through the use of tantalum repair plugs and special shaped patches which are studded directly to the steel. In many cases severely corroded nozzles and openings in glassed steel equipment have been repaired using tantalum sleeves. Without the use of tantalum these units would have to be returned to the vendor for re-enameling.

One example comes from a J.T.B. Engineering Department report which states:

"A large $12,000 glassed steel reactor developed severe corrosion at the bottom outlet nozzle. The extent of damage was so extensive that the vendor's service engineers were brought in for consultation. In their opinion any repairs would be highly questionable. J. T. Baker maintenance personnel felt that a successful repair could be made using a special modified tantalum sleeve. The process was kept 'on stream' for over two years before the reactor had to be returned for re-enameling."

Free Tantalum Test Kit

A corrosion test kit, available without charge to research technicians, contains both tantalum sheet and wire. Request it on your letterhead.

The above condensation is typical of articles which appear in CORROSIONOMICS, a Fansteel publication. Mail us your name for inclusion on our mailing list.

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G575A

change from...

40 MESH

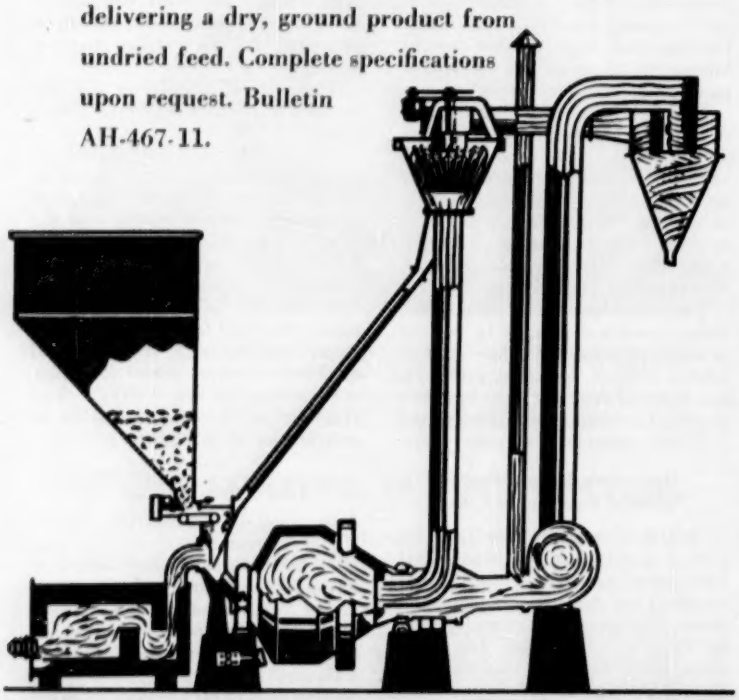
to

400 MESH

. . . in a few minutes, without interrupting operations. Yet any desired mesh may be maintained continuously. Ease of adjustment and close product control are possible with the . . .

"Gyrotor" Air Classifier

The Hardinge Gyrotor Classifier system, combined with a Hardinge grinding mill is an integrated grinding, classifying and product conveying system. Also available with an air-heating furnace for delivering a dry, ground product from undried feed. Complete specifications upon request. Bulletin AH-467-11.



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LITERATURE . . .

Agitators & Mixers . . . . . Patented standpipe around propeller shaft assures positive agitation and circulation. Open type, air lift and Super Agitator models are available. Bulletin A2-B4.
328a *Denver Equipment Co.

Air Distribution. . . . . Want cleanest air possible for ventilation or air conditioning system? Westinghouse unfolds answer in new brochure describing package air distributing unit. Request details.
440A Westinghouse Electric Corp.

Bubble Trays. . . . . Lightweight Truss-Type bubble trays are simple in design and can be adapted to any process requirements, any flow type, vessel size and layout. Request Catalog 150.
348 *Glitsch Co.

Centrifugals. . . . . Company's centrifugals make maximum use of time and space, with top safety. Used in separation, extraction, dehydration, clarification, coating, etc.
87 *Amer. Tool & Machine.

Centrifuges. . . . . You can operate this centrifuge for as long as a month without shutting down for cleaning. It periodically desludges itself automatically while running at top speed. Bulletin 946.
168-9d *Pfaudler Co.

Chlorinator. . . . . Unit can feed up to 8,000 lb./day chlorine and is adaptable to any type of chlorinator control; plastic construction for corrosion resistance. Catalog sheet 25.130 brings details.
440B Wallace & Tiernan Inc.

Classifiers. . . . . Gyrotor classifier system, combined with a grinding mill, is an integrated grinding. classifying and product conveying system. Complete specifications available in Bulletin AH-467-11.
440 *Hardinge Co.

Cleaning, Chemical. . . . . Technical bulletin tells how you can clean process equipment without dismantling, scraping, rodding or sand-blasting, by in-place chemical circulation. Request a copy.
324. . . . . *Oakite Products Inc.

Compacting Equipment. . . . . Mechanical process system includes a compacting mill to densify fines into flakes or slabs, a rolling mill to granulate them, a screen to separate them. Bul. 25C6177J.
221. . *Allis-Chalmers Mfg. Co.

Crushers, Jaw. . . . . Forced-feed jaw crushers have cast steel frames, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection, lengthen roller bearing life. Bul. C12-B12.
328d *Denver Equipment Co.

Crushing & Grinding. . . . . Bulletin 067 gives a full description of all Sturtevant laboratory machines, including crushing rolls, jaw crushers, swing-sledge mills and sample grinders.
78 *Sturtevant Mill Co.

Demineralizers, Water. . . . . Catalog 127-A details every type of Barnstead demineralizer; two-bed, four-bed or mixed-bed, for producing pure demineralized water up to 2500 gallons per hour.
TL463b *Barnstead Still & Demin.

*From advertisement, this issue

Dryer-Blenders.....Conical dryer-blender is a glassed steel unit that dries and blends materials simultaneously, can work with all acids except hydrofluoric and alkalis below pH 12. Sheet 26.
168-9e *Pfaudler Co.

Dryer, Pellet.....The Rotaircool is an efficient pellet cooler and dryer designed especially for small and medium pellet production requirements. Bulletin 177 brings complete details.
441A Sprout-Waldron & Co.

Dryers.....Oriad or Convection type dryers are designed for guarding pneumatically operated instruments, drying process gases and inerts, pressurizing anhydrous liquids, etc. Bul. D-100.
69 *C. M. Kemp Mfg. Co.

Dryers.....If moisture were pink, you would see this danger signal and take steps to remove the water from the air. As it is, you need dehumidification equipment. "Because Moisture Isn't Pink".
104 *Pittsburgh Lectrodryer.

Dryers.....Linde molecular sieves can dry your gases, air, hydrogen, chemical streams, more thoroughly than any other chemical adsorbent. Data sheets on "Drying of Gases" are offered.
313 *Linde Co.

Dryers.....Denver standard dryers are available in several types, including direct heat, indirect heat and steam tube. Company offers to solve your drying problems. Bulletin D4-B2.
328j *Denver Equipment Co.

Dryers, Rotary.....If you have a dewatering, drying or cooling problem, company's experienced engineers with their pilot plant can assist you. For quick reference, request Catalog "A".
*Davenport Mach. & Fndry Co.
T452

Dust Collector.....Low-cost dust filter combines features of a cyclonic dust separator and high efficiency of a dust filter. Get efficiencies up to 99.99%; request Bulletin 560 for details.
441B Day Sales Co.

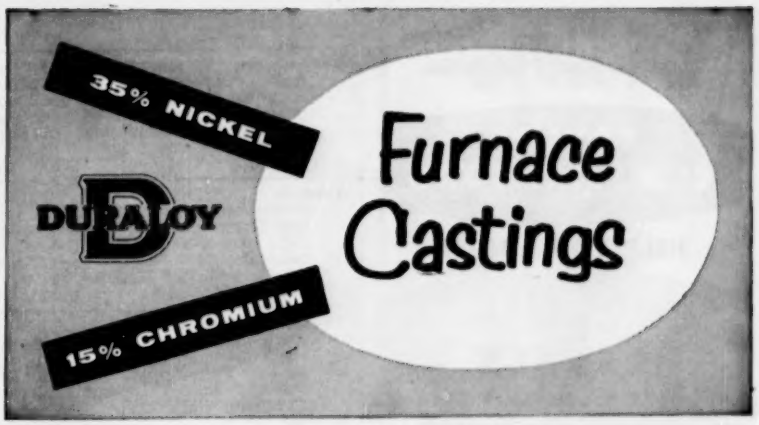
Dust Collectors.....Ducon dry-type dust collectors provide the continuous operation needed to capture nuisance dusts and to recover usable product most effectively. Bulletin DC-49.
349 *Ducon Co.

Dust Control.....Efficient Pangborn dust collectors trap dust at the source and gather it ready for resale, re-use or disposal. They give lower housekeeping costs, longer machinery life. Bul. 922.
220 *Pangborn Corp.

Dust Filters.....Roll-Clean Dynaclone self-cleaning dust filter has easier filter bag changing, greater cloth area, fewer operating parts, free-rolling cleaner, complete dust seal. Catalog.
377 *W. W. Sly Mfg. Co.

Dust Precipitators.....Electronic air cleaners offer high velocity operation, high efficiency, smaller face area and lower costs. Catalog 1460 gives details of new Precipitron air cleaners.
441C Westinghouse Electric Corp.

*From advertisement, this issue



Here are two good examples of our work in high-nickel castings!

These are in the Duraloy HT group calling for Ni 33.37 percent. We've gone as high as 68% nickel on some castings where extremely high temperatures and very severe corrosive conditions had to be resisted. The important factor concerning castings for exceptionally high temperatures is that they must retain their structural form under load.

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If you would care to have our metallurgist study your casting problem, we shall be glad to have you call upon us for the service

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Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading.

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414 RODGERS FORGE RD. • BALTIMORE MD.

LITERATURE . . .

Evaporators, Wiped Film.....The floating carbon blades of the wiped film evaporator, acted upon by centrifugal force, spread your distillands into very thin, uniform films. Data Sheet 39.
168-9b *Pfaudler Co.

Feeders.....Denver wet reagent feeder accurately meters minute quantities of liquid from 0 cc. to 2000 cc. per minute. It is used in multiples for higher capacities. Please write for Bulletin F6-B9.
328e *Denver Equipment Co.

Feeders, Chemical.....Manzel chemical feeders are simple in design, ruggedly built and unfailingly accurate. Fully adjustable for metering any desired amount of liquid. Complete Catalog.
325 *Manzel Div.

Filter Aids, Diatomaceous.....Dicalite Filteraids can remove all unwanted particulates, even those down in the sub-micron range, to give unsurpassed clarity of filtrate. Request Bulletin B-13.
217 *Great Lakes Carbon Co.

Filter Cloth..... For the most uniform and most accurate metallic filter cloth, specify Newark. Company manufactures all weaves and all metals, with a filter cloth to meet your needs. Catalog E.
R445 *Newark Wire Cloth Co.

Filter Fabrics.....You don't have to be a filter fabric expert when you can rely on Wellington Sears specialists. Company offers information in "Filter Fabric Facts", available on request.
84 *Wellington Sears Co.

Filter Presses.....Filter Presses can thoroughly wash the cake while it is still in the filter press chamber, deliver the filtrate to a higher level than the filter. Request Sperry Filtration Cat.
R427 *D. R. Sperry & Co.

Filters, Air.....Three types of units offer small space requirements, maintained performance over wide range of conditions, constant exhaust volume and high collection efficiency. Buls.
22-3 *American Air Filter.

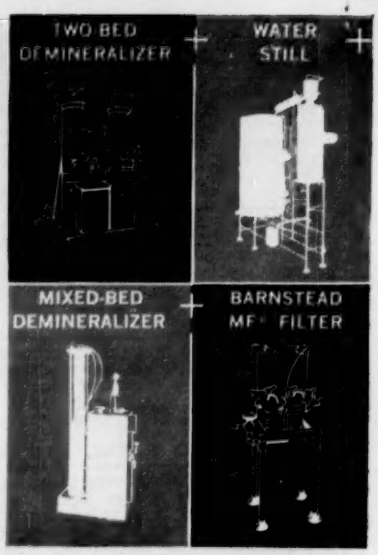
Filters, Disc.....Specially designed media is a fluffy white blanket of bonded glass fibers, which compresses to paper-like thinness on the roll and loads like film in a camera. Get Bulletin 248A.
385 *American Air Filter.

Filters, Disc.....Specially designed segments in Denver disc filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, without blowback. Bul. FG-B1.
328f *Denver Equipment Co.

Filter Media.....Catalog 57 gives complete information on company's line of metallic filter media—tables, diagrams and illustrations. Also lists services offered for special filtering problems.
442A Multi-Metal Wire Cloth Co.

Filters, Stainless Steel.....Designed for high-temperature (1000 F.), high differential pressures and filtering corrosive fluids, filters are fabricated in a variety of sizes. Catalog 54-101.
442B Cuno Engineering Corp.

*From advertisement, this issue



THIS BARNSTEAD EQUIPMENT OPERATING IN SERIES PRODUCES *10,000,000 OHM WATER IN PRODUCTION QUANTITIES

This entirely new standard of water purification by Barnstead now makes new advances possible in Chemical, Electronic, and Nuclear fields, where water of the highest purity is needed.

PUREST WATER . . . . HOH ABSOLUTE

The above combination of Water Demineralizers, Water Still, and Barnstead MF Filter, operated in series, will produce 10,000,000 OHM Water in production quantities . . . free of bacteria, organics and silica. Whatever your water purification problem, Barnstead engineering coupled with Barnstead's extensive line of Pure Water equipment has the authoritative answer. Write today for the answer to your water purification problem. *Corrected to 25°C.

NEW LITERATURE:

Catalog "G" describes Barnstead line of Water Stills from ½ to 1000 g.p.h. Catalog 127, lists Mixed-Bed, Two-Bed, and Four-Bed Demineralizers. Bulletin 141, on MF Filter which filters out particles to 0.45 micron.

Barnstead
STILL & DEMINERALIZER CO.

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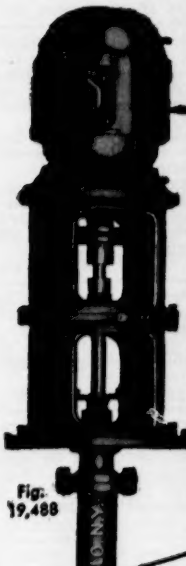
FIRST IN PURE WATER SINCE 1878

for PUMPING CHEMICAL SOLUTIONS!

FIG. 6061



Write for TABER BULLETINS C-355 for HORIZONTAL PUMPS ... for VERTICAL PUMPS V-837

Fig. 19,488

TABER PUMPS ARE specially built for handling chemical solutions, efficiently and economically . . . in the processing industries. The Vertical design permits locating stuffing box above and out of liquid level. Therefore nothing to leak.

BULLETINS as above gladly sent on request.

TABER PUMP CO. Est. 1859 320 ELM ST., BUFFALO 3, N.Y.

TABER

LITERATURE . . .

Flotation Equipment . . . . . Denver "SubA" flotation equipment, laboratory and commercial types, give maximum recovery at a low cost per ton. Simplified continuous operation. Bulletin F10-B81.
328g *Denver Equipment Co.

Injector, Drum-Top.....No pumps or motors—operates on a few inches of vacuum. Injects fluid to nearby or remote points directly from drum; meters up to 1 gal./hr. Request brings more details.
443A Sterling E. Norcross.

Jet Exhausters.....Designed to resist corrosion while performing vacuum pumping or liquid and gas mixing operations, exhauster can be fabricated in a wide range of materials. Request Bulletin 4P.
443B Schutte & Koerting Co.

Mills.....With Hy-R-Speed mills you save on capital investment, on operation cost and on maintenance. No skilled operator required; rust proof contact parts. Send for a copy of new bulletin.
343 *J. H. Day Co.

Mills.....Large scale production mills are available with integral feeding devices to handle a wide variety of materials, and with automatic controls for particle sizing. Bulletin M-527.
BR462 *Gruendler Crusher & Pulv.

Mills, Attrition.....Bulletin 143 describes Sprout-Waldron single runner attrition mill, which rubs, cuts, tears, crushes, grinds, granulates, pulverizes, twists, curls, hulls and blends.
57 *Sprout-Waldron Co.

Mills, Ball.....Steel-head ball mills are available with five types of discharge trunnions, all-steel construction. Low initial cost due to quantity production. Send for helpful Bulletin B2-B13.
328b *Denver Equipment Co.

Mills, Dispersion.....Improved way of wet milling, grinding, homogenizing, dispersing, emulsifying and extracting. Mill serves as its own pump and actually cleans itself. Information offered.
168-9f *Pfaudler Co.

Mixers.....Baker Perkins builds a complete line of mixing and kneading equipment for the chemical process industries. Catalog CE-57 describes machinery and testing laboratory service for mixing problems.
443C Baker Perkins.

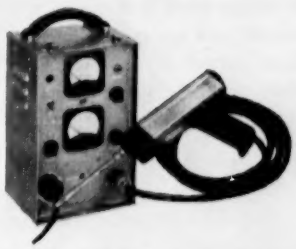
Mixers, Pipeline.....Exclusive design for continuous pipeline mixing, increased product uniformity, simplified piping layouts, etc. Suitable for high capacities, pressures. Request Bulletin 531.
382d *New England Tank & Tower.

Mixers, Portable & Tripod.....For portable, open tank, or closed tank installations, in 1/6 to 2 HP sizes, with standard NEMA vertical C flange motors. Drip-proof construction. Spec sheets.
382b *New England Tank & Tower.

Mixers, Side Entering.....Standard units available in 1/3 to 30 HP sizes, offering a variety of speed reduction designs, motor mounts, stuffing box modifications etc. Request Bulletin 532.
382c *New England Tank & Tower.

*From advertisement, this issue

SNIFFS LEAKS IN SECONDS



GENERAL ELECTRIC'S HALOGEN LEAK DETECTOR—Type H-1—locates leaks in seconds . . . enables you to test complete units in minutes. Compact, lightweight, and portable, the supersensitive H-1 detector requires no special operating skill. Its extreme sensitivity, fast response, and versatility make the H-1 the most useful and positive leak detector available . . . and at a low cost to you.

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To find out how the H-1 leak detector can be applied in your work, fill out and mail coupon to: General Electric Company, Section B585-60, Schenectady 5, N. Y., or call your nearest General Electric Apparatus Sales Office.

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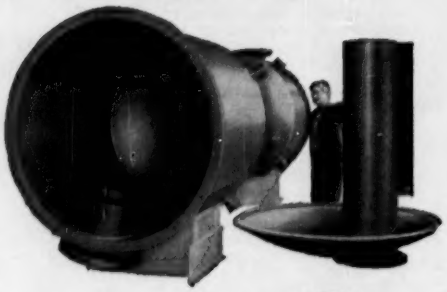
Stainless Steel Fabrication by KIRK & BLUM



With 50 years of experience in the field, KIRK & BLUM offers economical fabrication to the most exacting specifications.

Stainless fabrication is quite different from conventional steel working. KIRK & BLUM engineers and workers have the special knowledge and techniques to do an outstanding job.

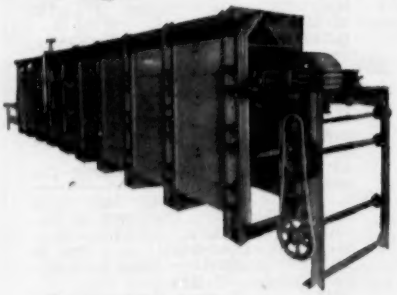
In all-important welding, for example, you are assured intelligent control of these factors which contribute to a first quality fabrication job:

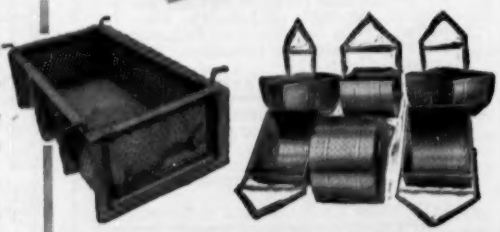
—selection of the best process . . . metallic arc or inert gas arc welding, seam or spot welding.

—prevention of distortion and warpage.

—restriction or removal of discoloration.

—isolation of chemical and physical properties from disturbance which might lead to corrosion.





Whatever your requirements, KIRK & BLUM facilities are at your service. For prompt quotation, send prints and details to: The Kirk & Blum Mfg. Co., 3208 Forrer St., Cincinnati 9, Ohio.

KIRK & BLUM
SHEET METAL FABRICATION

LITERATURE . . .

Mixers, Tank Top.....Feature clean, efficient designs with minimum moving parts. Variety of motors, shafts, stirrers and supports furnished to meet specific needs. Request Bulletin 551 now.
382a *New England Tank & Tower.

Process Equipment.....“Working for Profit”, a pocket-size booklet, shows how many processing companies simplify production, improve products and cut handling costs with company’s equipment.
279 *Swenson Evaporator Co.

Process Equipment.....To prevent discoloration, taste, odor or metallic pick-up in your process, you’ll find best piping, pumps, valves & tanks among ACE rubber & plastic materials. CE-50.
332a *Amer. Hard Rubber Co.

Process Equipment.....For chemical, processing and pulp and paper industries: 20-page bulletin contains information on complete line of company’s processing equipment. Bulletin 178.
444A Sprout, Waldron & Co.

Processing Equipment, Centrifugal..... For evaporating, distilling, heating or cooling, Adjust-O-Film equipment achieves superior results with thin-film processing. Bulletin 575 describes principles.
444B Kontro Co.

Radiation Equipment.....Traveling wave linear electron accelerator, designed for research in radiation chemistry, is offered for lease or sale; 2-10 million electron volts. Bulletin gives details.
444C **Applied Radiator Corp.**

Reactors, Atomic.....An atomic reactor is being made with a polyethylene moderator. Can be used for applied research, radiation testing, educational purposes. Said to be versatile, cheap. TD 1284.
293-4f *U. S. Industrial Chem. Co.

Reactors, Glass-Lined.....Spherical glass-lined reactor is designed to operate at 330 psi internal pressure and 250 psi in the jacket. Lined with chemical-resistant glass. Bulletin MG-100.
28-9 *Glascote Products Inc.

Reactors, Glassed Steel ....The symmetrical heads of Series “R” glassed steel reactors make for easier, faster and much more flexible installations. Higher jacket velocity. Bulletin 960.
168-9a *Pfaudler Co.

Samplers.....Heavy duty units, extra rigid track and ball bearing wheels assure positive travel and timing of sample cutter in Denver automatic samplers. Wet and dry cutters. Bulletin S1-B4.
328c *Denver Equipment Co.

Separators, Magnetic.....Permanent Alnico magnetic pulleys protect process machinery from tramp iron and remove contaminating iron particles from materials and products. Bulletin C-1007A
417 *Dings Magnetic Separator.

Stills, High Vacuum.....16-page folder outlines development of the high vacuum still. Included are specifications and diagrams of company’s line of vacuum stills and data for typical high-vacuum distillations.
444D Arthur F. Smith Co.

*From advertisement, this issue

5 more of these 36" babies . . .

Norwalk *Engineered* to *keep gas and air under positive control*

We are proud of the reorders we receive. As a result of past experience, five more of these big Norwalk check valves, 5 feet long and engineered for 36" pipe diameter, are being installed by one of our good customers.

In pipe sizes from ⅜" to 42" or larger, Norwalk valves give dependable service with exceptionally low pressure drop, at practically no maintenance cost.

For engineering assistance and quick service in controlling gas and air flow at high or low pressures—*Call Norwalk*

INDUSTRY'S COMPLETE LINE

Check Valves Pipe Sizes ⅜" to 42". Screwed End Models to 4".

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Pressure Controllers Pressures to 5 psi.

Appliance Regulators Pipe Sizes ½" to 2".

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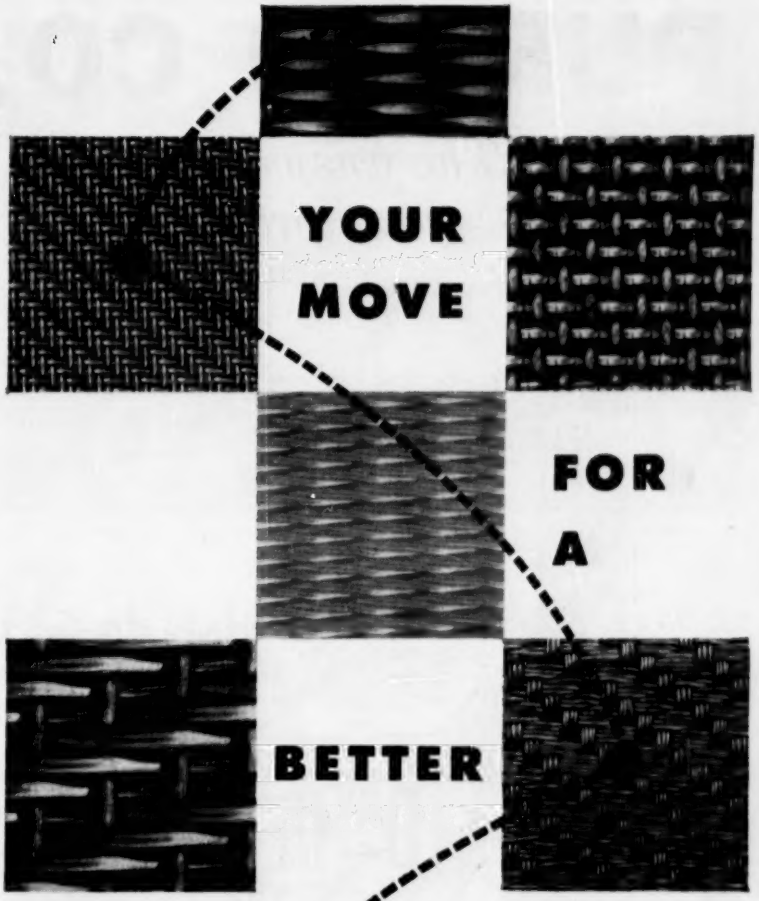
Complete Engineering Cooperation

NORWALK VALVE CO.
Established 1878
SOUTH NORWALK, CONN.
Boston • Chicago • Cleveland • Detroit
Los Angeles • Minneapolis • New York
Philadelphia • Pittsburgh
San Francisco • Washington, D.C.



Metallic Filter Cloth

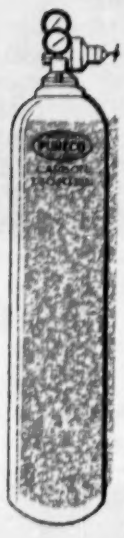
NEWARK *for* ACCURACY

For the most uniform, most accurate metallic filter cloth, specify NEWARK. All weaves, all metals for all types of service, there's a NEWARK filter cloth engineered to meet your requirements. Send for our New Catalog E.

Newark Wire Cloth COMPANY
351 Verona Avenue • Newark 4, New Jersey

PURECO CO_2

The answer to your problem?



Investigate CO_2 as an Inert Gas for

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Use CO_2 as a Refrigerant for

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grinding, plastics, resins, gums, etc.
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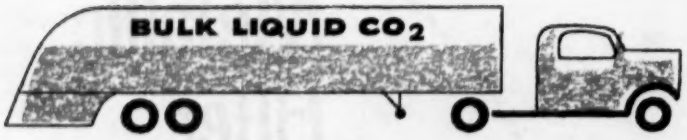

Specify CO_2 as an Ingredient in

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Pureco CO_2 is quickly available—in solid "DRY ICE", liquid or gaseous form from over 100 sales and service depots. There are also a variety of Pureco CO_2 supply systems available—cylinders—cylinder banks, converters, receivers—each "tailored" to fit your particular requirements.

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A Division of Air Reduction Company, Incorporated
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AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

LITERATURE . . .

Stills, Water.....Water stills from ½ to 1000 gallons per hour capacity are described in detail in Catalog "G". Electrically heated, gas heated and steam heated models, accessories of all types.
TL463a *Barnstead Still & Demin.

Strainers.....Designed for high-speed straining of feed to centrifuges and other processing machines, bulletin 2700 describes design and operation of Merco strainers. Copies available on request.
446A Dorr-Oliver.

Tables, Concentration . . . . . Denver Wilfley concentration tables are ideal for separation of groups of particles having a similar range of specific gravities. Bulletin T1-B3 is offered.
328h *Denver Equipment Co.

Water Treatment.....Catalog "G" tells about line of water stills from ½ to 1000 g.p.h.; Catalog 127 lists mixed-bed, two-bed and four-bed demineralizers; Bulletin 141 describes MF filter.
R442 *Barnstead Still & Demineral.

Water Treatment.....Company's custom engineering offers a lower cost method of treating water. The correct plant for the job demands a knowledge of the water's end-use, volume, etc. Fact File.
L462 *H. M. Mueller Co.

Wire Cloth.....For every filtering, straining, or sizing job, company's wire cloth with specially developed alloys is stronger, longer wearing, resists corrosion and heat. Screen Reference Catalog.
422 *Ludlow-Saylor Wire Cloth.

Pumps, Blowers, Compressors

Compressors.....If you need oil-free air, take advantage of Joy's more than 25 years of experience with non-lubricated compressors and send for informative, free Bulletin 130-11 now.
7 *Joy Mfg. Co.

Compressors.....Motor-driven, turbine-driven or engine-driven, Cooper-Bessemer compressors are available in sizes from 200 to 6,000 horsepower, for pressures to 15,000 and vacuums. Bul. M-81.
371 *Cooper-Bessemer Corp.

Compressors.....Three new bulletins describe entire line of Westinghouse unit type and Le Roi stationary air compressors; ½ to 100 hp, both single and two-stage units. Ask for free literature.
446B Westinghouse Air Brake Co.

Compressors, Air.....Booklet is designed to provide engineers and users of air compressors with all data necessary for maximum efficiency in operation. Covers all types from ⅛ to 20 hp.
446C Wayne Pump Co.

Fans.....Bulletin 775 will bring you information on new LS-type direct-driven fans offering better performance in low static pressure ranges. Available in ring, square panel or duct types.
446D Aerovent Fan Co.

*From advertisement, this issue

Pumps.....Kinney Heliquad pumps are ideal for pumping highly viscous materials, semi-solids that must be heated to pump and liquids containing non-abrasive solids. Bulletin L51A.
97 *Kinney Mfg. Div.

Pumps.....Moyno is the only pump that can handle abrasives, pastes, slurries, chemicals, suspended solids, etc., without foaming, aerating, crushing or excessive pump wear. Bulletin 30-CE.
121 *Robbins & Myers Inc.

Pumps.....These pumps are designed for pumping corrosive or noncorrosive liquids, with or without solids in suspension. Will stand up under pressures to 400 lbs. Full details in Bulletin 723.4.
416 *Goulds Pumps Inc.

Pumps.....Illustrated Bulletin 300 shows specifications, dimensions, construction features and complete selection table for general service Unipumps. Efficient, dependable and truly versatile.
436 *Weinman Pump Mfg. Co.

Pumps.....Vertcial pumps, described in Bulletin V-837, have stuffing box located above and out of liquid level, with nothing to leak. Bulletin C-355 describes horizontal pumps.
L443 *Taber Pump Co.

Pumps, Centrifugal.....Data sheet 357 aids in selection of proper type and size of pump and proper construction of sump chambers. Data presented in easy-to-read charts and nomographs.
447A Allen-Sherman-Hoff Pump.

Pumps, Chemical.....Company builds ten special types of chemical pumps in a wide choice of trim for almost any corrosive, abrasive or high-consistency liquid. Ask for Bulletin 982 now.
116e *Buffalo Forge Co.

Pumps, Controlled Volume.....Lapp Pulsafeeder is a combination piston-diaphragm pump, designed for accurate handling of corrosive and non-corrosive liquids. Data available in Bulletin 440.
103 *Lapp Insulator Co.

Pumps, Corrosion Resistant.....Both metallurgically and mechanically, P. D. pumps are designed to meet the rigid demands of the chemical industry in pumping corrosive products. Get 1957 Catalog.
433 *Waukesha Foundry Co.

Pumps, Diaphragm.....Teflon-faced diaphragm permanently bonded to elastomeric backing provides chemical resistance, long life. Packless design, lifelong lubrication. Send for Bulletin 301.
326a *Hills-McCanna Co.

Pumps, Heat Transfer.....Heat transfer pumps are specially designed for high-temperature liquids. They employ watercooled bearings and packing, with suitable alloys. Engineering data is offered.
116d *Buffalo Forge Co.

Pumps, High Pressure.....Type "RR" multi-stage pumps combine rugged strength and efficiency on boiler feed and other clear water service against heads as high as 1500 feet. Request Bulletin 980.
116b *Buffalo Forge Co.

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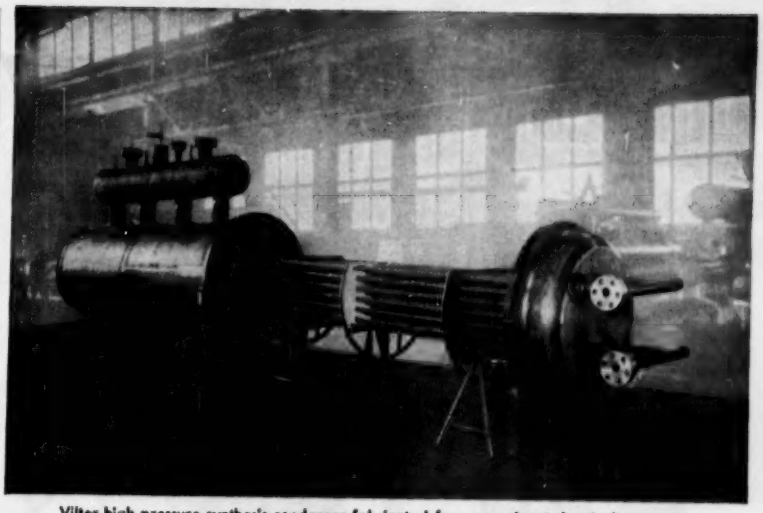

Vilter high pressure synthesis condenser fabricated for a prominent chemical company.

Q- How did Vilter cut costs on a High Pressure Synthesis Condenser?

A. Through practical redesign of the condenser tube lay-out.

A real challenge was tossed at Vilter a short time ago. How to produce a high pressure synthesis condenser to meet design specifications . . . yet meet the customer's budget requirements.

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Vilter makes all four basic types of heat exchangers: shell and coil, shell and tube, shell and tube bundle, and atmospheric . . . and in every possible modification. Vilter can give you the most efficient heat exchange equipment and pressure vessels with working pressures as high as 10,000 psi for specific purposes. Consult with Vilter.

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FOR BULLETINS 427 AND 707

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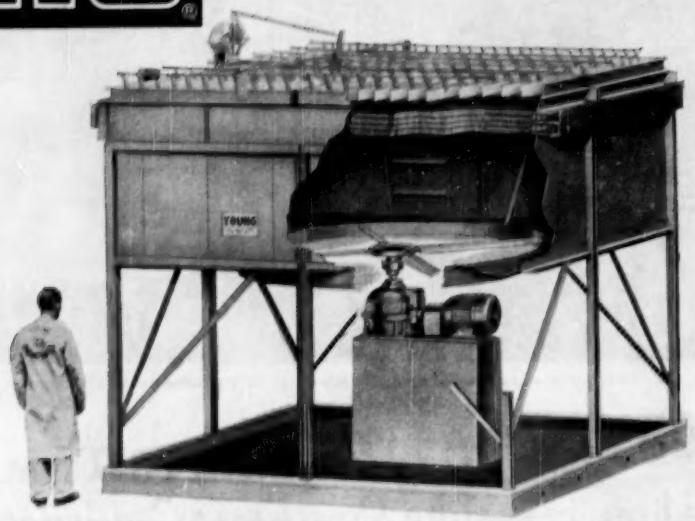
THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin
Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

HC HORIZONTAL CORE UNITS by Young



Design features that make this HC® unit a dozen ways better

Young atmospheric coolers are capable of meeting a wide range of cooling requirements. Illustrated is one of several units cooling natural gas at a pipeline compressor station. Cutaway shows some of the superior construction features.

1 • **ROUND TUBE CORES** for liquid pressures up to 150 psi or greater. Gas or vapor cooling up to 2500 psi and greater are obtainable.

2 • **MONOBLOC TUBE CONSTRUCTION** of superior design provides greater "bursting strength" with increased heat transfer surface.

3 • **REMOVABLE COVER PLATE** on end tanks for easy inspection and maintenance on cores operating up to 150 psi; removable plugs opposite each tube on cores for higher operating pressures.

4 • **TUBE-FIN ASSEMBLY.** The positive mechanical bond of fin to tube ensures maximum performance, unaffected by hot and cold cycles.

5 • **HORSEPOWER REQUIREMENTS** are lower because of decreased air flow resistance.

6 • **BAFFLE PLATE ARRANGEMENT** allows for more liquid passes—higher tube velocity—consequently takes better advantage of cooling surface.

7 • **FRAME.** Uprights and braces from heavy gauge channel steel; cover plates of heavy gauge sheet steel.

8 • **BRACING.** Plenum chamber is braced at intervals for structural rigidity, and to dampen vibration which may be caused by air turbulence.

9 • **TUBE REPLACEMENT,** where operating conditions necessitate, on both Monofin and Monobloc construction is easily accomplished.

10 • **ASME** code specifications can be furnished on cores where required.

11 • **FINS.** Straight in-line design reduces air resistance, provides for greater cleanliness.

12 • **PLENUM CHAMBER** designed to take full advantage of all heat transfer surfaces, equalizes distribution of air.

Write for new catalog 557 Dept. 317-L

"WHERE QUALITY COUNTS"

Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

LITERATURE . . .

Pumps, High Pressure.....High pressure liquid ends, ball-guiding cone seat valves machined from solid steel bar. Highly polished stainless steel or ceramic pistons. Bulletin HP-1254.
355 *American Meter Co.

Pump, High Vacuum.....New design provides electronic method for producing "dry" vacuum in the range from 10^{-4} to 10^{-6} mm. Hg; operate six months without breaking vacuum for pump servicing. Bulletin 6-140.
448A Consolidated Electrodynamics.

Pumps & Homogenizers.....New bulletin contains complete information on Hydropulse pumps and homogenizers. Pumps are hydraulically operated, sanitary, leakproof, high pressure and pulsation free.
149 *Scott & Williams Inc.

Pumps, Metering.....Catalog of chemical feeders is designed to provide users of metering pumps with complete specifications for quick selection of the right pump; covers company's complete line.
448B Manzel Pumps.

Pumps, Non-Clogging.....For moving high-consistency liquids, diagonally split-shell pumps offer freedom from expensive shutdowns. Available rubber-lined for corrosive liquids. Bulletin 953.
116c *Buffalo Forge Co.

Pumps, Process.....Peerless products for the chemical industries include can type process pumps, high temperature hot oil pumps condensate return pumps, chemical transfer pumps, etc. Bulletin.
80 *Peerless Pump Div.

Pumps, Proportioning.....Chemical proportioning pumps will operate at rated pressures 24 hours a day for as long as a year and a half without a major overhaul. Information in Bulletin 4065-C.
91 *Amer. Instrument Co.

Pumps, Proportioning.....Model 1140 proportioning pump feeds all chemicals (alkaline, neutral, or acid). Interchangeable measuring cylinders, super-accurate check valves. Send for Bulletin 1140.
434 *Proportioneers Inc.

Pumps, Rotary.....Viking, a leader in the rotary pump field, offers information on its line of pumps in Bulletin Series 573. One pump can do a variety of important jobs. Available on request.
L459 *Viking Pump Co.

Pumps, Turbine.....F-M Pomona water-lubricated turbine pump is easy to install and adjust, simple to change between electric, belted or geared drive. Full details in illustrated Bulletin 6957-1.
388 *Fairbanks, Morse & Co.

Pumps, Water.....For clear water service there is no more efficient pump than the double-suction type "SL". Hydraulic balance, free-flow water passages, husky construction. Bulletin 955.
116a *Buffalo Forge Co.

Tank Vents.....OPW tank vents trap and hold vapors and release only at set pressures, insuring maximum protection and savings. OPW Tank Venting and Emergency Relief Recommendation Chart.
18 *Jordan Corp.

* From advertisement, this issue

Services, Processes, Misc.

Camera, Photomicrographic.....12 p. brochure illustrates and describes the three basic components of company's Orthophot Model 1300 unit: camera, vertical column, illuminator.
449A American Optical Co.

Centrifuges.....8 p. brochure describes five small and medium angle centrifuges. There is a complete reference chart shown various combinations of tubes that can be accommodated in five rotors.
449B Ivan Corvall, Inc.

Chlorine Handling.....Bulletin WWC-3B4 covers handling of chlorine liquid and gas from container to dispenser; gives pertinent facts about chlorine, lists safety precautions and aids chlorine system design.
449C Fischer & Porter Co.

Construction.....Atlas gives you a completely integrated construction service, one that will take full and sole responsibility for your job and will guarantee every aspect of it. Bulletin CC-3.
362 *Atlas Mineral Prods.

Contract Engineering.....12 p. brochure describes such services as machine design and fabrication, equipment layout, equipment and material procurement, equipment installation.
449D Teller Co.

Data Processing.....Booklet describes operation and application of tape-operated automatic data handling equipment. Machines can be used to simplify many problems in paper work processing.
449E
Friden Calculating Machine Co.

Equipment Fabrication.....32 p. color brochure describes operation of this custom fabricator of process equipment and pressure vessels. Describes all major fabricating equipment, test facilities.
449F Chicago Steel Tank Co.

Fire Extinguishers.....New buyers guide give information on fire extinguishers, including dimensions, discharge ranges, laboratory approvals and classifications and other data. TD 1290.
293-41 *U. S. Industrial Chem. Co.

Gloves, Coated Fabric.....New catalog describes company's full line of industrial work gloves; fully illustrated and contains chart showing chemical resistance of the various coated fabrics.
449G Granet Corp.

Glycerine Process.....A new fermentation process for the production of glycerine from molasses is described in a 8 p. brochure. Illustrated flow sheet shows feed stocks and products including byproducts.
449H Scientific Design Co.

Hearth Furnace Suspensions.....Bulletin 857 discusses practical modernization of open hearth furnaces to increase capacity more economically; features Reintjes suspended refractory hung arch.
449I Geo. P. Reintjes Co.

* From advertisement, this issue

Pat. Pending

AUTOMATIC REFLUX HEAD

Explosion-proof, electrically-operated for high vacuum, pressure and temperature, and for corrosive and hazardous service. Eliminate reflux control problems with its simple, accurate and dependable operation.

COLUMN REDISTRIBUTOR
PAT. NO. 2,639,130

Distributes liquid evenly over the packing and minimizes channeling. Improvements to 100% in plate efficiency are usually possible. Especially suitable for vacuum distillation. Readily installed in existing installations.

Reflux Heads and Redistributors are available in most metals and made in all sizes including large diameters. For further information write for Bulletin No. 55-1.

DISTILLATION ENGINEERING COMPANY
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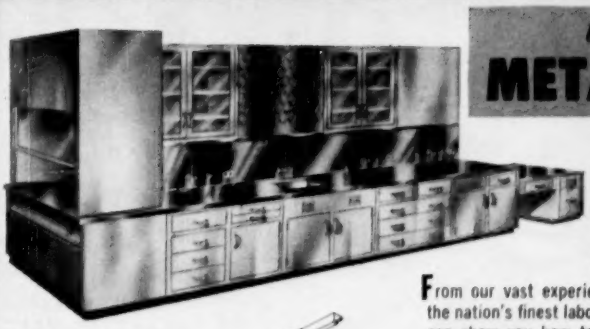
IMPROVE YOUR LABORATORY *with* MODERN, FUNCTIONAL, EQUIPMENT



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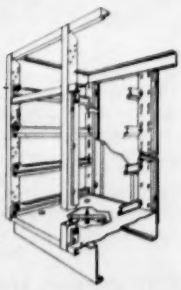

Cutaway view of our standard base unit: This construction technique permits you to interchange drawers and cupboards by utilizing the same base cabinets as your laboratory requirements change.

METALAB mass-production methods, which have been adapted to custom laboratory equipment and furniture results in "custom" quality units at "standard" prices.

From our vast experience in laying out the nation's finest laboratories, METALAB can show you how to obtain maximum working and storage area in a minimum of space... how to make current equipment adaptable to any possible future needs... and how to achieve true economy in laboratory equipment. This know-how, plus the use of only the finest laboratory-tested materials, assures you of obtaining the most at Metalab for your laboratory budget.

Our Engineering Dept. will be pleased to solve your laboratory planning problems without any cost or obligation on your part. Write today for our literature!

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MAXIMUM CONTROL
WITH
MINIMUM PRESSURE DROP
270 SERIES
BAR STOCK VALVES
FLOW IN CUBIC FEET PER HOUR
This flow curve for air at 30 psi shows the excellent control obtainable with minimum pressure drop in Hoke's 270 Series bar stock needle valves. The O-ring stem seal will pass a helium leak test...and there's no packing adjustment, no friction even at high pressures. Self aligning stem shuts off tight. For hydraulic and pneumatic equipment, gas analysis, pilot plants, test instruments of all types. 1/8" to 1/2" pipe sizes in carbon, chrome or stainless steel and brass.
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INCREASE OPERATING
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METALLO METALLIC RASCHIG RINGS—Offer maximum possible contact surfaces, develop highest scrubbing capacity, thoroughly disperse liquids and gases, have a remarkable long life even under severest operating conditions, are structurally stronger to withstand the stresses of heavy loading, are unaffected by sudden extreme temperature changes, will not crumble regardless of pressure.
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We also supply METALLO metallic LESSIG RINGS to act as efficient liquid distributors by eliminating cross flows in all workable metals.
metallo gasket co.
14 BETHANY STREET
NEW BRUNSWICK, N. J.

LITERATURE . . .

Laboratory Equipment.....Batch and continuous test models of crushers, screens, ball mills, pulverizers, rod mills, classifiers, agitators, mixers, pulp distributors and several others. Bul. LG3-BIO.
328i *Denver Equipment Co.

Laboratory Furniture & Fume Hoods.....Company offers revised edition of "Steelab" with ideas for lab furniture layout, and "Fume Hoods" 56H, describing the safe and easy remote controlled fume hoods.
340 *Laboratory Furniture Co.

Laboratory Ware.....Polyethylene ware for laboratories and clinics is described in an 8-page bulletin. Items include beakers, aspirator bottles, tubing, pipet-fillers, vials, carboys. TD 1287.
293-4i *U. S. Industrial Chem. Co.

Ladder Rungs.....Four-page brochure describes uses and advantages of Relgrit non-skid abrasive ladder rungs. Last as long as steel and provide safe footing on even wet or oily ladders.
450A Reliance Steel Products Co.

Mass Spectrometer....."Mass Spectrometer Analytical Service," 8 p., describes facilities available on a per analysis basis to resolve problems in chemical analysis, process monitoring, leak detection.
450B Consol. Electrodynamics.

Pressure Chamber.....Test unit provides pressures up to 30,000 atm. in a chamber ½" in dia. by 10" high; full pressure in 5 min.—holds pressure for a week without attention. Ask for bulletin V-10.
450C Nucor Research.

Reclaiming Rubber.....13 p. booklet describes company's Reclaimator process by which rubber can be reclaimed to a high standard in 24 min. instead of 24 hr. required by conventional methods.
450D U. S. Rubber Reclaiming Co.

Refrigeration....."Wolverine Serves the Refrigeration Industry," 12 p., describes units destined for the refrigeration and air conditioning industries. Illustrations show refrigeration cycle unit.
450E Wolverine Tube Div.

Research.....20 p. booklet called "Product Research and Development" contains sections on product planning and design, materials, production and processes. Includes illustration of projects completed.
450F Franklin Inst. Labs.

Spectacles, Safety.....Ultrascopic safety spectacles in a modern two-tone onyx on clear crystal plastic frame combine true safety with smart good looks. Request informative Brochure S-6761.
110 *American Optical Co.

Sprinkler Systems.....Blaw-Knox engineers, fabricates and installs automatic sprinkler systems that are always alert to detect, confine and quench a fire at its origin. Bulletin 2426.
66a *Blaw-Knox Co.

Water Treatment.....Reprint T-155 discusses problems encountered by a paper mill when increased capacity required effluent treatment. Paper presents the problems and gives the solutions.
450G Graver Water Conditiong Co.

* From advertisement this issue

panel mounted Pyrometers with Alnor® Accuracy

Alnor Pyrometers are designed to give consistently accurate temperature readings under the most severe conditions of vibration, dirt and corrosive atmosphere. Sturdy, laboratory-precise movements are cushioned in fume-proof, splash-proof welded steel cases in front of board or flush type mountings. Six series available for up to 31 circuit applications. Eleven standard ranges covering 0-300° F. to 0-3000° F. or centigrade equivalents.

Single-circuit series data is covered in Bulletin 4371.

Multi-circuit series data covered in Bulletin 4361. *Circle* number you wish; attach this ad to your letterhead, and mail to: Illinois Testing Laboratories, Inc., Room 559, 420 N. LaSalle St., Chicago 10, Ill.

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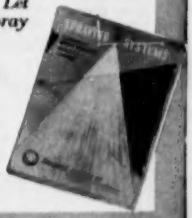
remember final control is the SPRAY NOZZLE you use!

In design . . . choose the Spray Nozzles that give you proper performance, with exact spray pattern, impact, spray angle and capacity. In application . . . be sure the nozzles as supplied are produced to close tolerances. Metallurgically, make certain the spray nozzles fit your use.

With Spraying Systems you can be sure of spray nozzles to meet all three requirements. *Let Spraying Systems Co. recommend Spray Nozzles to meet your needs best.*



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Spraying Systems Co. Catalog No. 24 . . . 48 pages, with complete performance data. Write for your free copy.

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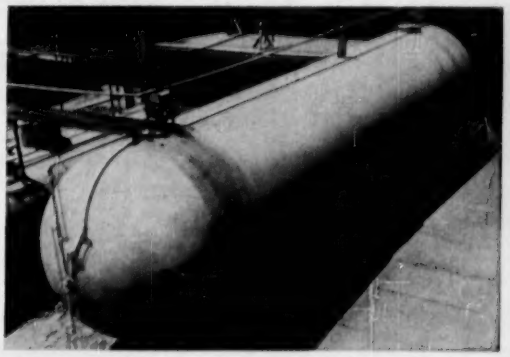

• We have been supplying the chemical processing industry with tanks and vessels for chemical storage for three generations. In addition to carbon and stainless steel, we also fabricate and erect tanks, pressure vessels and processing equipment of aluminum and special alloys. . . . Investigate our facilities and take advantage of our 103 years of specialized knowledge and experience. . . . Write for *Tank Talks.*

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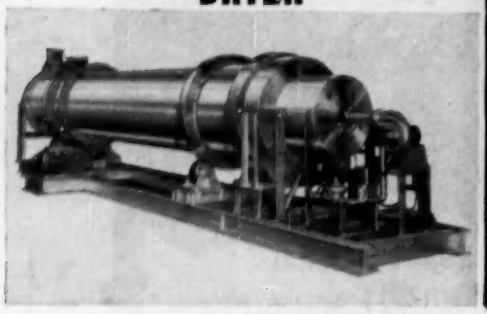

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Steam Tube, Hot Air and Direct Fire

Atmospheric DRUM DRYERS

ROTARY COOLERS
Water and Air

DRYING AND CALCINING WELDING FLUX

After less than two years of successful operation of a "DAVENPORT" Rotary Dryer — Calciner used to process welding flux, this company has purchased their second "DAVENPORT" for this same application. Both units were supplied with automatic gas firing.

If you have a De-Watering — Drying or Cooling problem, our experienced engineers with our pilot plant can assist you with your problems. For quick reference, see Chemical Engineering 1957 catalog, or write for our Catalog "A"

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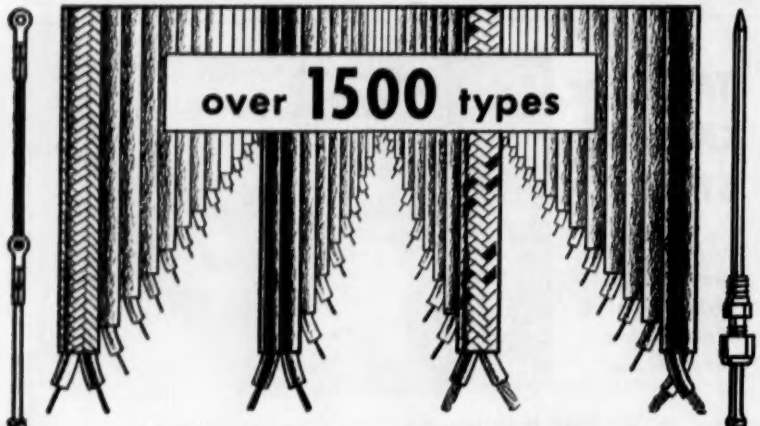

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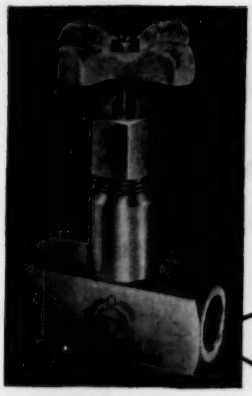

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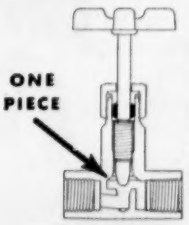

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#55 FACING MATERIAL

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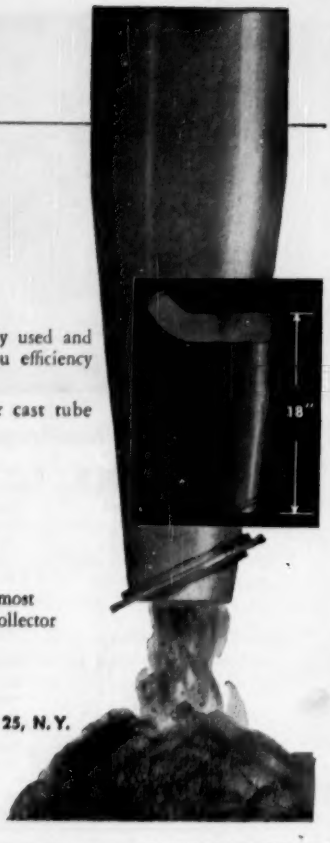

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ULTRA-PURE PROCESS WATER

completely automatically

Looking for a Demineralizer effluent with a purity in excess of 15-meg ohms? And fully automatic operation on a "Packaged" unit basis? Then consult Penfield — the pioneer designer and manufacturer of "Packaged" Demineralizers for industry's most critical needs.

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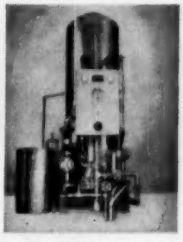
Each Penfield Demineralizer is shipped completely assembled — ready for instant operation upon simple connection with a plant's service lines. Write today for specification sheets on a Penfield "Packaged" unit that will fulfill your requirements for ultra-pure process and make-up water.



An ultra-pure effluent in excess of 15-meg ohms is produced by this fully automatic Model MA Penfield Mono-Column Demineralizer. When purity falls below pre-set standards, the need for regeneration is automatically signalled. The setting of a single switch then accomplishes a complete regeneration cycle, including rinsing and recutting in effluent when desired resistivity (purity) is reached. Model MA units are available with flow rates from 200 to 5,000 G.P.H.

Special Point-of-Use Demineralizing System . . . Each operator's bench is equipped with a T-20 Penfield Mono-Column unit (inset picture) that supplies up to 40 G.P.H. of 10-meg ohms and better water for critical rinsing and make-up needs. Operating costs remain low since the units' mixed bed cation and anion resins are regenerated by the Penfield SR-1 Regenerator (main picture) — an in-plant component of this special Penfield Demineralizing System.

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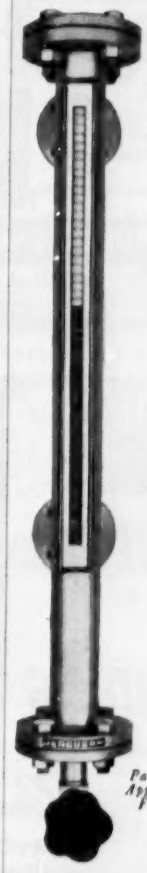
MAGNETIC GAGE

For Liquid Levels



An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

Distinct, accurate level shown in red contrasted with silver above.

Job designed, correlating pressure, temperature, and specific gravity.

For pressures up to 2500 lbs. @ 600° F.

Patent Applied For

Can also be used for interface indication.

Write now for engineering sheet on Jerguson Magnetic Gages.

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Gages and Valves for the Observation of Liquids and Levels

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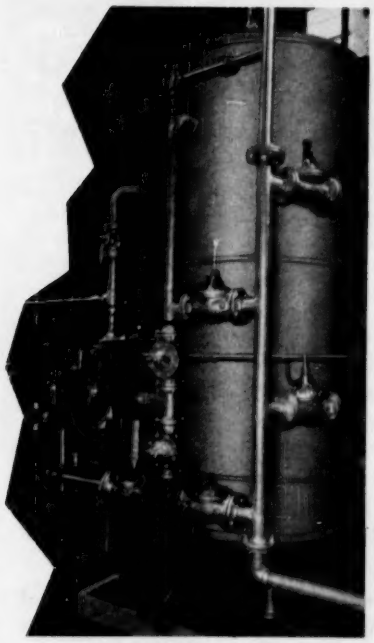
Shift Personnel

Operate this Pilot Controlled

Monobed Deionizer

REGENERATION CHEMICALS REQUIRE NO DIRECT HANDLING, DILUTION



Plant workers handle all regeneration operations by manipulating the two pilots in central control panel.

DIRECT SUPERVISION by highly paid technicians is *unnecessary* with a HMM Deionizer. This one has been in service three years in a major U. S. pharmaceutical house. It delivers 100 gpm of ultrahigh purity process water with a peak load of 200 gpm. Minimum water quality is 1-15-million ohms/cc, measured continuously. Regeneration acid is drawn from carboys and caustic from storage—*directly*—eliminating pumps, leakage and secondary mixing.

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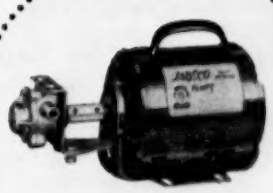
cut pumping costs with

JABSCO INDUSTRIAL PUMPS



Model 4010-01
PORTABLE PUMP & MOTOR UNIT
¾" Port Size—Bronze Construction

- INSTANTLY SELF-PRIMING
- SIMPLE, COMPACT, ONLY ONE MOVING PART
- DURABLE NEOPRENE IMPELLER
- SELF-LUBRICATED
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HERE'S another Jabsco industrial pump – designed and built for chemical, pharmaceutical and other industrial applications. Ideal for transfer of various liquids and acids – sump drainage, coolant pumping, general transfer, pulp in solution, filtering, brines, plating solutions – even fluids containing foreign matter or particles, silt, crystals, and other gritty materials. Bronze, stainless steel or plastic construction is available to *solve your specific* pumping problems.
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- Condensers
- Evaporators
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- Ribbon Mixers
- Agitators
- Reactors
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- Heat Exchangers
- Reboilers

Materials: All Carbon Steel Body except the #304 Stainless Steel Head
Physical Dimensions: Over-all Height 23'—
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Top Section 4' Long—30" Dia.
Weight: 3800 lbs. (Empty)

Here is another example, among the thousands of case histories in our files, of how Manning & Lewis clearly and logically interpret customers requirements . . . from original concept to finished quality product.
Both the saving in time and cost resulting from our years of engineering experience are two important factors why more and more manufacturers are turning to M & L.
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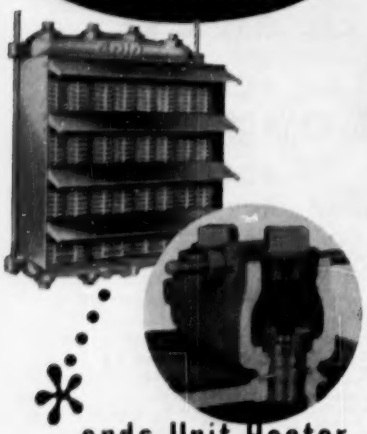
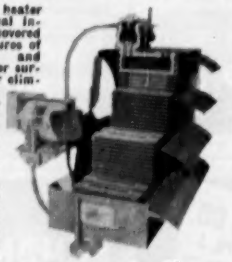
GRID* Cast Iron Steam Heat Transfer Surface

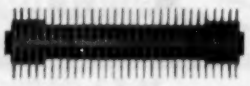


*ends Unit Heater Maintenance Problems!

Your answer to unit heater problems the Chemical industry has discovered through common failures of copper, aluminum, and steel tube heat transfer surface. GRID condenser eliminates internal electrolytic corrosion—because all metals in contact with steam are similar. GRID also eliminates external corrosion — because the cast iron construction resists acid or other fumes in the air and eliminates the use of reducing valves where high steam pressure is used. GRID cast iron construction is tested to withstand steam pressures up to 250 P.S.I.... 450° temperature. GRID eliminates the high maintenance costs generally experienced with other types of condenser construction . . . eliminates replacement costs because GRID is built to last for years . . . uninterrupted service records of more than twenty years are common among GRID users in the Chemical industry.



Note double steam chambers in each fin section and wide fin spacing.



Above illustration is all cast iron one - piece, single chamber fin section used in Models 1000 and 1200. The illustration above is all cast iron one-piece double chamber fin section used in Models 1500 through 3000 . . . wide fin spacing prevents clogging by lint or dust . . . straight through air passage reduces resistance. Single inlet at top serves both steam chambers permitting quick, even steam distribution.

Send for the complete story on GRID Unit Heaters, GRID Blast Heaters, and GRID Radiation for chemical plant use . . . it is contained in GRID Products Catalog No. 956. Write today for your copy.

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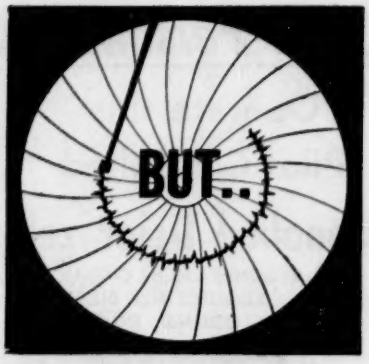

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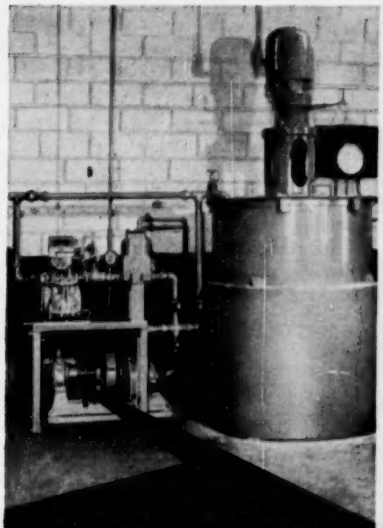

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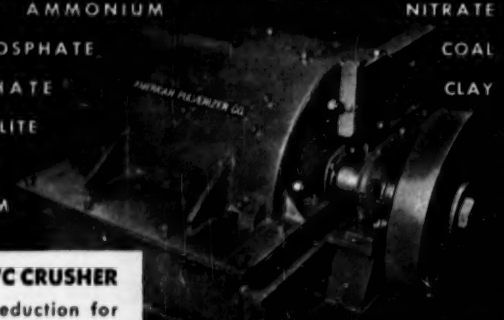

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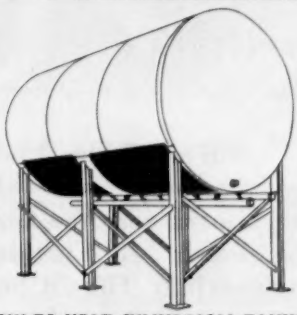

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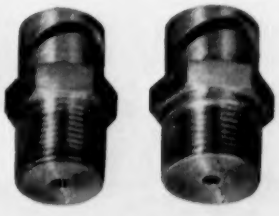

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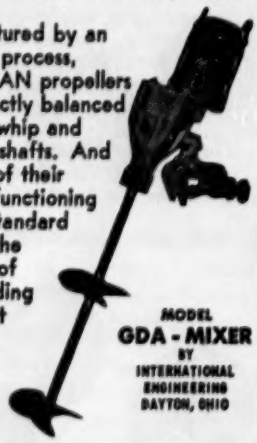

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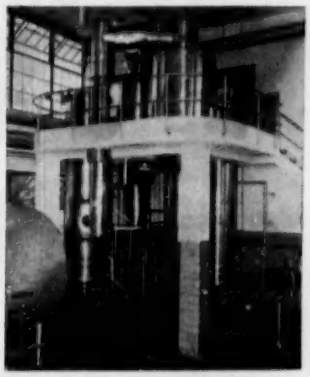

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3—Link Belt Roto Louvre 5'2" x 20', 6'4" x 24', 7'5" x 25'.
4—Devine double door Vacuum Shelf 17 and 20—59" x 78" shelves.
1—Devine single door Vacuum Shelf 20—40" x 43" shelves.
6—Stokes single door Vacuum Shelf 4, and 6—24" x 36" shelves.
2—Devine 5' x 33', 4' x 25' Rotary Vac.
1—4' x 20' Rotary 304 S. S.
3—Louisville Steam Tube 6' x 50', 8' x 35', 38" x 25'.
2—Buflovak Atmospheric double drum 42" x 120", variable speed drive.
1—Buflovak 5' x 12' Atmos. single drum.
2—Devine 4' x 9' Atmospheric single drum.
4—Tray Dryers, steam heated, 95 sq. ft.

FILTERS

2—Feinc 5' x 6' 304 S.S. Rotary Vac.
1—Shriver 30" P&F., 304 S.S. 20 chambers.
5—Sparkler 33-S-28, 150 sq. ft. 304 S.S.
1—Sparkler #14-D-4, 304 S.S. NEW
1—Oliver Rotary, Monel 8' x 10'.
1—Oliver 3' dia. Monel Horizontal.
1—Oliver 5'3" x 8' Steel Rotary Vac.
1—Elmco 18" x 12" 316 S.S. Rotary Vac.
2—Sweetland #12, 48 and 32 leaves.
2—Sweetland #10, 27 bottom drainage leaves.
1—Sweetland #7, 20 S.S. covered leaves.
3—Shriver 30" P&F, 36 chambers, iron.
1—Shriver, 30" P&F, 40 chambers.

CENTRIFUGALS

5—Bird 32" x 50" solid bowl Continuous Centrifuges 316 S.S. fume-tight, 60 HP TEFC motors, NEW 1953.
2—Bird 36" x 50", 18" x 28" steel, solid bowl, continuous.
2—Bird 24" x 38", 18" x 28", 316 S.S. Solid Bowl, continuous.
1—Sharples PY-14, Super-D-Canter, 304 S.S.
2—Bird 40" suspended, 347 S.S.
1—Bird 40" suspended, rubber.
3—Tolhurst 40", 32", 26", suspended.
1—AT&M 40" suspended, steel.
1—AT&M 36" center slung, rubber covered, perforated basket.
1—Tolhurst 32" Suspended, 304 S.S. perforated basket.

EVAPORATORS, REACTORS CONDENSERS, TOWERS, TANKS

1—Artisan 450 sq. ft., 304 S.S., single effect Evaporator, complete with piping, receiver, separator and condenser.
1—Nooter 1000 gal. nickel-clad, jacketed, agitated Reactor.
2—Pfaudler 250 gal. glass lined, jacketed, agitated Reactors.
1—Pfaudler 100 gal. S.S., jacketed, agitated, Reactor, XP motor.
3—Pfaudler 500 and 300 gal. glass lined, jacketed Reactors.
1—600 gal., 316 S.S. jacketed, agitated Reactor 200# internal pressure, 75#.
4—3500 gal., 304 S.S. jacketed, agitated.
1—Wyatt 18" dia. x 23', 316 S.S. Bubble Cap Column.
1—Wyatt 24" dia. x 42', 304 S.S. Bubble Cap Column.
1—10,000 Aluminum Storage Tank 10' x 16' x ½" shell, 25# W. P.
1—12,000 gal. Horizontal rubber lined Tank 10'6" x 17'4".
4—1,000 gal. S.S. Clad, Vertical Tanks.
1—6' x 5', 316 S.S. Vertical Tank.
1—5'6" dia. x 16' long, 304 S.S. Horizontal Tank, 3000 gals.
3—Steel Storage Tanks 8½' x 25', 8' x 16', 6' x 20'.

HEAT EXCHANGERS

1—2545 sq. ft. Admiralty Tubes, 150 psi.
1—1300 sq. ft. Admiralty Tubes, 75 psi.
1—1220 sq. ft. 304 S.S. tubes, 150 psi.
1—1050 sq. ft. 304 S.S. tubes, 75 psi.
1—947 sq. ft. 304 S.S. tubes, 60 psi.
1—570 sq. ft. 304 S.S. tubes, 60 psi.
1—536 sq. ft. 304 S.S. tubes, 150 psi.
1—315 sq. ft. 316 S.S. tubes, 250 psi.
1—250 sq. ft. 316 S.S. tubes, 900 psi.
20—16, 20, 28, 48 & 68 sq. ft. 316 S.S. tubes.
7—Karbate 24.6 sq. ft. tubular.

PULVERIZERS—CRUSHERS

1—Dixie #3820 non-clog Hammermill.
4—NEW Jeffrey Hammermills, 20" x 12", 15' x 18".
4—Hardinge Mills, 4½' x 16", 5' x 36", 6' x 22", 10' x 48".
1—International 6' x 7' porcelain lined Pebble Mill, 30 HP motor.
4—Patterson 6' x 8', 5' x 6', 3' x 4' Mills.
1—Devine 5' x 10' steel jacketed Ball Mill.
1—National 6" x 12" Mill, Two Roll.
1—Kent 6" x 14" Three Roll Mill.
3—Gayco Air Separators 16', 6', 18".
2—Mikro Pulverizers, #2DH, 2TH.
2—Ball & Jewell #1, #0 Rotary Cutters.

SCREENS

3—#34 Robinson Triple Deck 30" x 104".
6—#42 Rotex Double Deck 40" x 84".
3—#421 Rotex single deck 60" x 84".
3—Robinson single deck 40" x 84", 304 S.S.
1—Patterson single deck 40" x 84", 304 S.S.
2—Tyler Hummer single deck 3' x 5', 3' x 10', 3' x 12' with Thermionic Units.

MIXERS

1—Baker Perkins #15USE, ALL STAINLESS double arm, jacketed, Vacuum.
1—Baker Perkins #15VUMM, 100 gal. jacketed, 100 HP.
1—Baker Perkins No. 16 TRM 150 gal. jacketed, sigma blades, Vacuum.
1—Baker Perkins 50 gal. jacketed, Sigma blades.
5—Day "Cincinnatus" double arm 250 and 100 gals.
5—Steel Powder 50, 225 and 350 cu. ft.
1—10 cu. ft. "V" Blender, 304 S.S.
1—Eppenbach 1 HP, 304 S.S. Homo Mixer.

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Devine & Stokes Impreg. Units 30" & 36" dia.
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6—Jacketed Kettles 75 to 4000 gals.
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Jeffrey 18" x 12" Single Roll Crusher.
Day Norwalk Spike Crusher 1½ H.P. motor.
Hammer Mills Pulverizers 3 to 50 H.P.

Bauer 24" Hammer Mill.
1—Schutz-O'Neil 20" Pulverizers. Also #1.
Williams #3 & 2xx Hammer Mills.
1—Robinson 18" & 22" Attrition Mill.
1—Lehman 4 Roll W. C. 12 x 36" Steel Mill.
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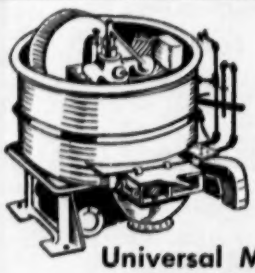

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6—W & P Mixers, jacketed, heavy duty, sigma blade 300 gal. with hydraulic dumpers.
3—Baker-Perkins Mixers—same as above.
2—Sperry 30" Filters, clad. del. 39-pl. 40 fr.

H. LOEB & SON :-: 4643 LANCASTER AVE., PHILADELPHIA 31, PA.

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STAINLESS STEEL TANKS

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1—10,500 Gal. Horizontal T-304, Dished heads, 3/16" thick
1— 5700 Gal. Horizontal
1— 5200 Gal. Vertical
2— 4500 Gal. Vertical T-304
1— 3000 Gal. Vert.-Mixing
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2— 2000 Gal. Vertical T-304
3— 1000 Gal. Vertical T-304
5— 500 Gal. Vertical T-304

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Patterson Kelley TWIN SHELL DRY BLENDER

- 3 cu. ft. Capacity
- Like new

2—International BALL MILLS

6' Dia.x8' and 6' Dia.x10'

- Porcelain Lined
- 25 H.P. Gearhead Motors
- Excellent Condition

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1—Hardinge Rod Mill 4' x 8' 50 H.P. H. Torque
7—Lightning Mixers—3 H.P. 431 RPM

3—Morris Cent. Pumps (Slurry)—
Size 2-R 150 GPM 60 ft head
Size 2 350 GPM 10 ft head
Size 2 120 GPM 120 ft head

1—Nash Double Suction Filtrate Pump Size D 34E 240 GPM 40 ft head
2—I. R. Chemical Pumps—Size 1½ MC 50 GPM 70 ft
1- I. R. Motor Blower—Type M-M310 (Volume C.F.M.—650)
1—50 H.P. Nash Hytor Vac. Pump Size H. 8
1—1½ ORV 3 I. R. Motor Pump 100 GPM 50 ft head
1—2 ORV 5 I. R. Motor Pump 225 GPM 50 ft head
1—Ross Dray Dryer
1—7½ H.P. Blower Rotary
1—1½ H.P. Small Blower Rotary
2—8' x 12' Oliver Vacuum Drum Filters
4—6 x 6' Eimco Vacuum Disc Filters
1—15 H.P. Nash Hytor Vacuum Pump Size H-6
3—20 H.P. Nash Hytor Vacuum Pump Size H-6
1—4' x 6' Eimco Drum Filter
1—Small Pug Mill 5 H.P.

3—Lengths 12" Screw Conveyor with motor drive
1—Length 1-8" Belt conveyor with drive for cake discharge from Disc filters
4—Slurry Tanks 7' Diameter x 5' deep Filtrate Receiving Tanks and Air separator Tanks for above vacuum filters
1—Tank for acidifying filtrate (Leg Tank)
1—Flow Meter Recorder (Brown)
2—Rubber Lined Acid Tanks—12000 Gal.
1—15000 Gal.
2—Hardinge 30 ft Diameter x 7 ft Deep Clarifiers

1—Hardinge Direct fired parallel flow 80" Diameter x 60' long. Class XH—12 Dryer with 14" Screw Feeder Complete
2—6' x 50' Louisville Steam Tube Dryers
1—Buell Dust Collector No. 34 Type AC-750 Cyclone

The above equipment is still installed and in excellent condition. Motors, piping, conduit etc for this equipment are also available, and all of the above items can be inspected at the address below—

Inquiries should be addressed to

T. R. Banks, Vice President
Hershey Estates (Extraction Division)
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FOR SALE
BAKER PERKINS HEAVY DUTY JACKETED 200 GAL. SIGMA BLADE MIXER
Excellent Condition
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Mojonnier Stainless Steel Vacuum Pan; 6' x 12' with S.S. Condenser Coil.
Four Stainless Steel Horizontal Tanks; 6' x 34'; 7000 gal. Dished Heads.
Blaw Knox Stainless Steel Resin Still or Autoclave; 7'6" x 7'6"; Jacketed.
Two Stainless Steel 5000 gal. Pressure Tanks; 10' x 6' with Agitators.
A. O. Smith Type 347 Stainless Autoclave; 1500 lb. ASME; 1200 gal. Agitated.
Stainless Horizontal Oval 4' x 6' x 21' Tank; Milk Type; 3500 gal. capacity; like NEW.
A. O. Smith Stainless Lined 20,000 gal. Pressure Tanks; 10' x 30'.
5000 gal. Heavy Duty Aluminum Tanks; 8' x 12' Vertical ASME Heads.
Pfaudler Glass Lined Jacketed Reactors; 500-1000 gal.
Lancaster Stainless Lined Rotary Reactor; 1700 gal. 300 PSI ASME; 50" x 17'4".
Western Precipitation Helo-Flight Desolventizer or Chlorophyll Extractor.

Inquire about Classification P4. Complete plants available for nearly every product. What do you want to make?

Rotary Cutters by Abbe, Ball & Jewell, from Lab. Size to Size No. 1-15 HP.
Mikro Pulverizers from Bantam size in Stainless up to No. 4 Model.
Raymond, Williams, Gruendler, Hammer Mills for heavy duty; all purposes.
Fitzpatrick Model K 7 Comminutating Mill in Stainless with 20 HP motor.
Patterson Buhrstone Lined Model D Pebble Mills; 6' x 5' and 6' x 8'.
International Porcelain Lined X24 Pebble Mills with 50 HP Gear Motors.
Gates Tube Mills 5' x 22' with manganese steel liners.
Hardinge Conical Ball or Pebble Mill; 10" x 36"; Silica Block Lining.
Sperry 36" ALUMINUM Filter Press; 33 Chambers; 4 eye with Hydraulic Closing.
Shriver STEAM JACKETED 36" Cast Iron Filter Press; 29 Chambers.
Stainless Steel 150 gal. Vacuum Filter; 35" x 35".
Sparkler Model 33D7 Filter with Scavenger; 2000 gal. per hr.
2 Plastic Extruders Royle No. 3 and NRM 2½" Screw-Oil Heated-Controls.
Stokes Rotary Tablet Presses; RB2; BB2; RD3; DD52; Colton No. 10-35
Baker Perkins (W. & P.) Heavy Duty Double Arm Jktd. Mixers to 300 gal. sizes.
J. H. Day Cincinnattus 1000 gal. Stainless Steel Mixer; Jktd., 75 HP motor.
Readco 750 gal. Double Sigma Arms Jacketed Mixer with Vac. Bowl; 200 HP.
Werner & Pfleiderer 1200 gal. Universal Mixer; Sigma Arms; Jktd., 150 HP.
Bird Continuous Conical Bowl Centrifugals; 18" x 28" and 36" x 50" Compl.
A. T. & M. 26" Stainless Steel under driven Centrifuge; perforate basket.
Tolhurst 40" Rubber Covered Suspended Centrifugals with Monel Plows.
Sharples H2 Nozzlejector with 15 HP Explosion Proof Motor; 1000 GPM.
Sharples C27 Super D. Hydrator; Type 316 Stainless; 30 HP Expl. Motor.
8 Stainless Steel Heat Exchangers or Condensers up to 1000 sq. ft. surface.
Barnstead Stainless Steel Steam Heated Water Still; 100 gals. pr hr.
Stainless Steel Vacuum Still; 755 gal. 4'6" x 6'; coil heated.
Stainless Steel Jacketed Vacuum Still; 425 gal.; 56" x 50".
Aluminum Bubble Cap Column 60 Plates; 27½" dia. x 36'; 11 Sections.
Zaremba Double Effect INCONEL Evaporator with Calandria, 430 sq. ft.
Buffalo Fractionating Column with Still Pot; Column 42" x 24'9" with 28 Bubble Caps.
Lummus Copper Alcohol Recovery Column; 18" x 21'; 5 sections.
Barnstead Stainless Steel Steam Operated Water Still; 100 gal. per hr.
Double Drum Dryers with Accessories; 28" x 60"; 32" x 72" and 42" x 100".
Raymond 2 Stage Flash Drying Installation in Type 316 Stainless Steel.
Hersey Rotary Gas Fired Counter Current Atmospheric Dryer; 5' x 26'; S.S.
Squier Stainless Clad Rotary Atmospheric Dryer; 30" x 20'; Hexagon.
Stokes Jacketed Rotary Vacuum Dryer; 34" x 10' Model 59 AB; accessories.
American Two Door Jacketed Sterilizers; all sizes up to 36" x 42" x 84".

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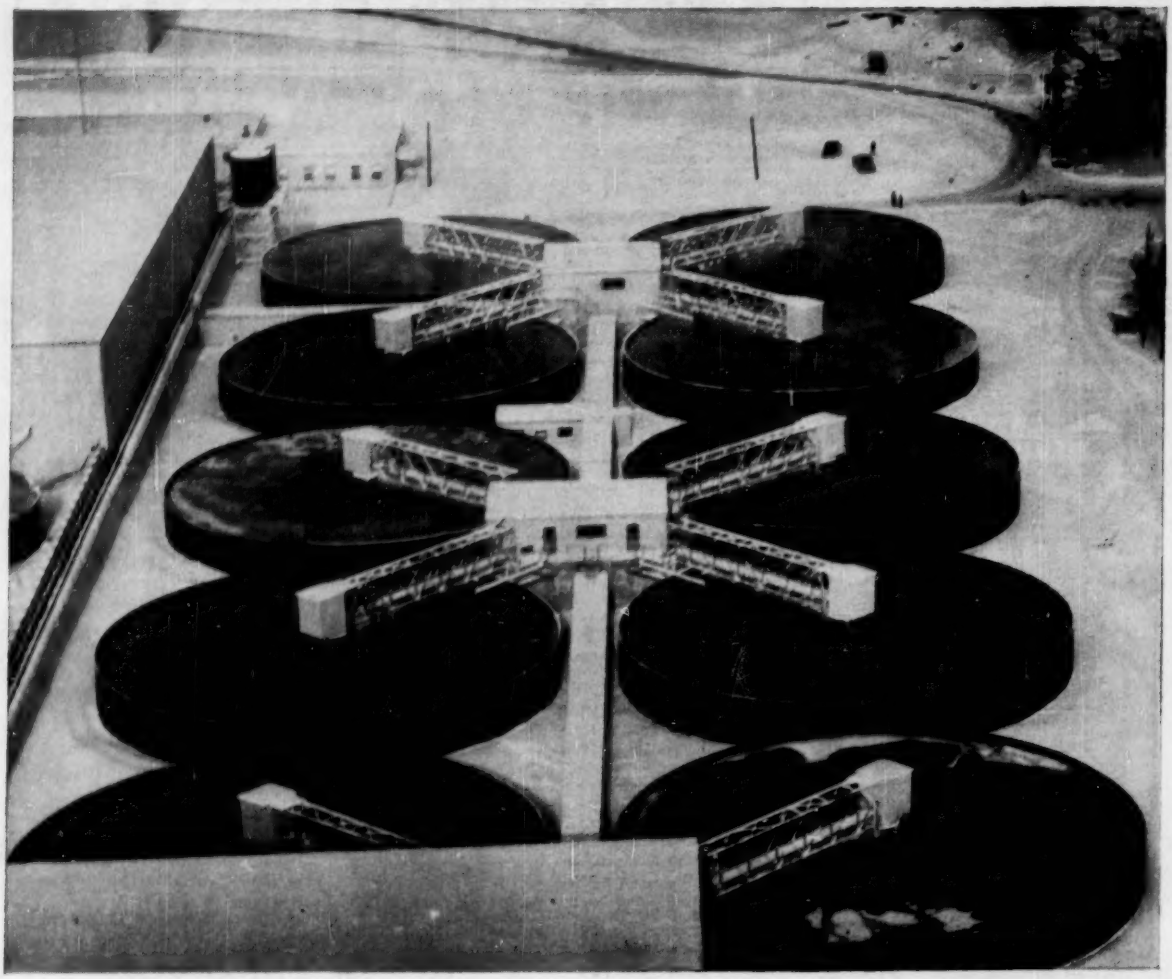
B.F.Goodrich report:



Uranium gets an acid bath

B. F. Goodrich improvements in rubber brought extra savings

Problem: Those steel tanks are part of the above-ground operation of the world's largest uranium mines, located in Ontario, Canada. Over 100 huge tanks are used in the process of separating uranium from the ore. But the acids used are so corrosive they would eat holes in the tanks, pipes, fittings and valves.

What was done: B.F.Goodrich engineers recommended rubber lining by the exclusive B.F.Goodrich Vulcalock process. The rubber lining is locked to the metal so strongly and tightly that it practically becomes a part of the metal. A square inch of it can stand a 500 pound tug without breaking loose. Even if the acid-proof rubber is accidentally punctured, the Vulcalock bond confines the damage to a small area where it can easily be repaired.

Extra benefits: This installation was lined in the field by specially-trained B.F.Goodrich craftsmen. It had to be finished quickly. Working at top speed, they lined over 100 tanks and miles of piping with 9½ acres of rubber.

Why specify B. F. Goodrich: Our tank-lining craftsmen have had a wide variety of experience in rubber-lining equipment in the field. Many of these jobs were big, spectacular; others were smaller, but all were handled efficiently due to the skill and ability gained by years of doing field work under difficult conditions. It's this combination of expert engineering ability, proven construction features, and skilled craftsmanship that insures the economy and efficiency of every B.F.Goodrich rubber-lined installation. *B.F.Goodrich Industrial Products Co., Dept. M-204, Akron 18, Ohio, or Tuscaloosa, Alabama.*

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INDUSTRIAL PRODUCTS

Write your own ticket—

MASTER
ALTERNATING CURRENT MOTOR

SERIAL	✔	STYLE	✔
TYPE	✔	FRAME ✔	H.P. ✔
VOLTS	✔	CYCLES	✔
AMPS.	✔	PHASE	✔
R.P.M.	✔	SERVICE FACTOR	✔
CODE	✔	TEMP. RATING ✔	
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What are your power drive requirements? Here at Master, with the widest selection in the nation to choose from, you're sure to fill your needs quickest and best.

Need something special in gear reduction—electric brakes—variable speed operation—fluid drive or special mounting? Or would some of our standard models (⅛ to 400 H.P.) fill the bill? You'll find the answer here! And remember, all Master components are engineered to form combinations of units in one streamlined, compact package of efficiency. Name your need and the name that fills it is Master—for greater salability of motor driven products; for increased productivity of plant equipment.

Motor Ratings..⅛ to 400 H.P. All phases, voltages and frequencies.

Motor Types.....Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.

Construction ....Open, enclosed, splash-proof, fan-cooled, explosion-proof, special purpose.

Speeds .....Single speed, multi-speed, and variable speed.

Installation .....Horizontal or vertical, with or without flanges and other features.

Power Drive Features .....Electric brakes (2 types)— 5 types of gear reduction up to 432 to 1 ratio. Mechanically and electronically-controlled variable speed units—fluid drives—every type of mounting.

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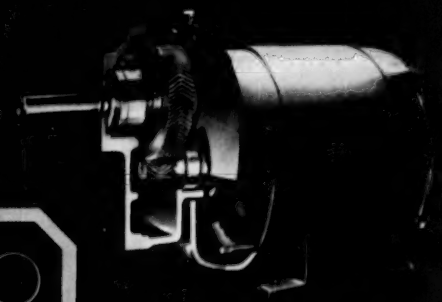
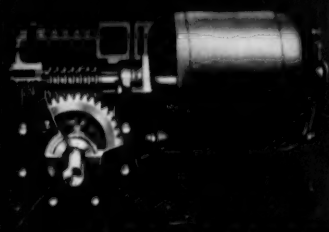
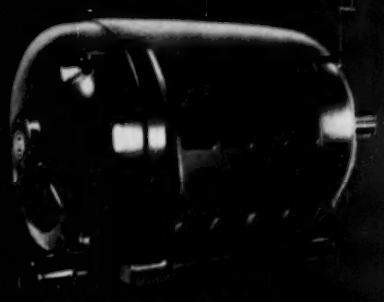
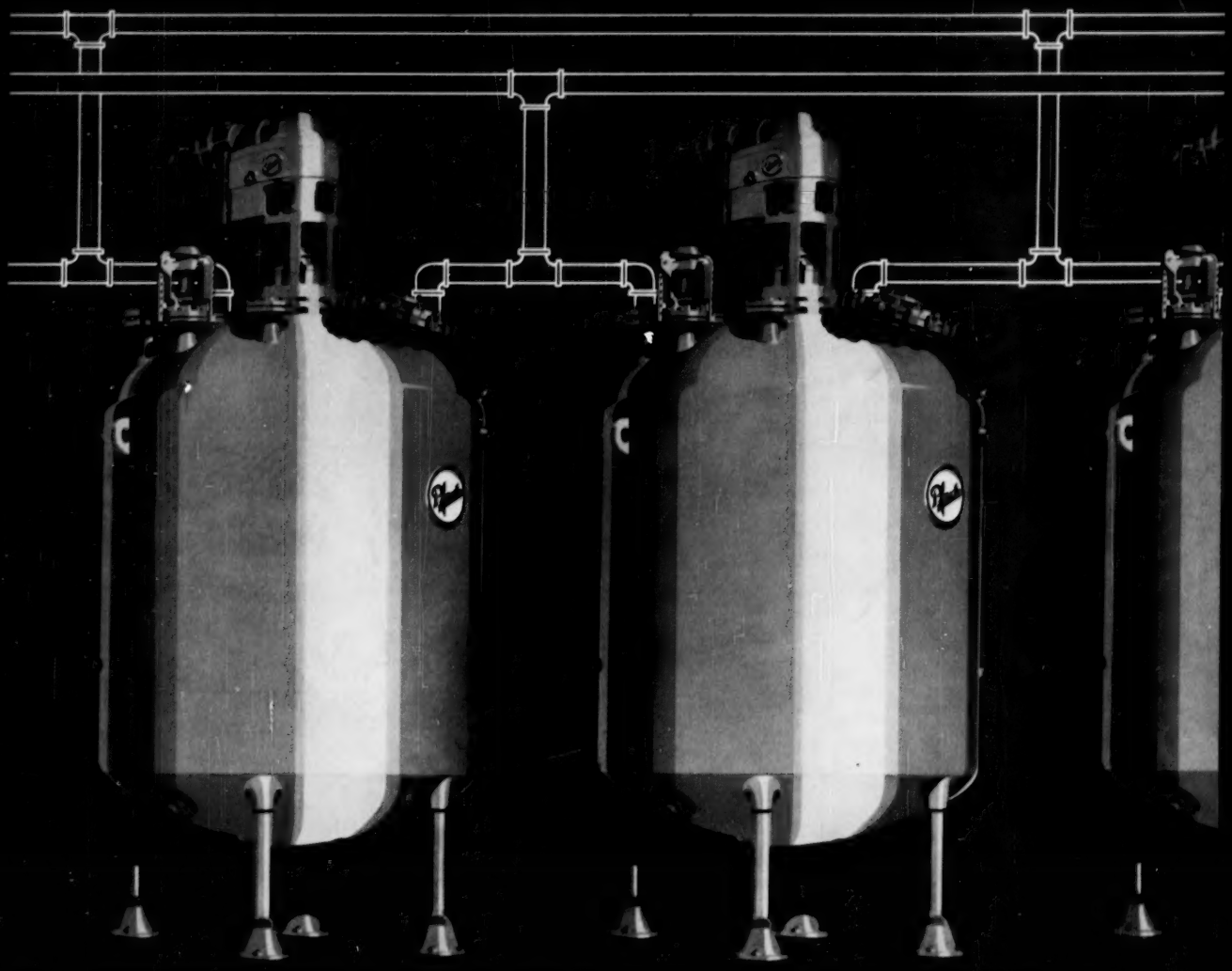

Parallel Shaft Gearmotors


Right-Angle Shaft Gearmotors

Unibrake Motors

Speedrangers


Standard Motors—⅛ to 400 H.P.



Newest glassed steel reactor in 20 years. Units shown are 1000-gallon "R" Series, rated at 100 lb. internal pressure with 90 lb. jacket pressure. Higher pressures available on special order.

Side to side piping possible with new "R" Series Reactors

Hooking up glassed steel reactors takes less time, less head room, and less pipe when you use the new "R" Series.

There are an equal number of nozzles on each half of the top head, placed in such a way that they form mirror images. With such symmetry you could, for example, feed two reactors off a single tee pipe . . . one on its left side, the other on its right side.

New drive mount adds space, flexibility

The new "BH" drive is pedestal-mounted, takes up less space than tripod mounts. This leaves more of the top head accessible to nozzles, observation windows, manhole, etc.

Stuffing box or seal . . . changed in minutes

You can switch from stuffing box to mechanical seal or *vice versa* without disturbing the drive alignment. It takes just minutes to insert a preassembled, pretested "Pfaudlerpac" seal of stuffing box whenever you want to change.

Permanently and perfectly aligned

The base plate for the drive support is *welded* to the reactor in perfect and permanent alignment. All the interlocking components align directly to this plate, so you can assemble the drive without further leveling.

Both drive and stuffing box or seal have antifriction bearings throughout to maintain this precision alignment and to reduce wear. The bearing span is greater so you get little or no run-out.

New reactor will be at Chem Show

There's more information about the new "R" Series on pages 168-169 of this magazine. You can learn still more by seeing us at the Chem Show, Booth 110,141, or by writing Dept. CEB-117 for our bulletin No. 960 on the "R" Series.

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